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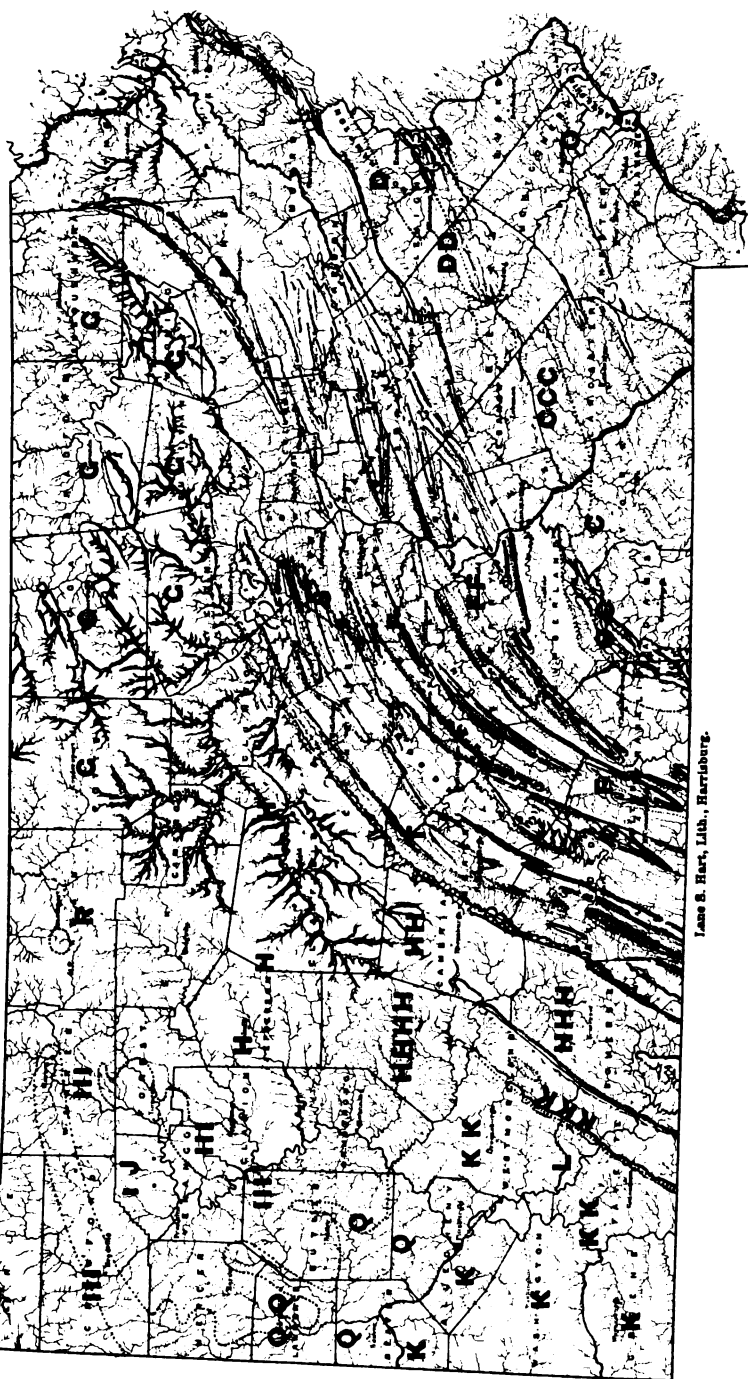
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Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876 & 1877.



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SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:
1876.

REPORT OF PROGRESS

IN THE

FAYETTE & WESTMORELAND DISTRICT

OF THE

BITUMINOUS COAL-FIELDS

OF

WESTERN PENNSYLVANIA,

BY

J. J. STEVENSON.

PART I.

Eastern Allegheny County and Fayette and Westmoreland Counties west from Chestnut Ridge.

✓
Illustrated with 50 Woodcuts and 3 County Maps, colored.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.
1877.

C

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Prof. J. P. LESLEY,

Director of the Second Geological Survey of Penn'a.

SIR: I have the honor of submitting herewith my report on so much of the Fayette and Westmoreland district as was examined during 1876. Field work was begun early in May, and was continued until the close of November.

I have to make grateful acknowledgment of the readiness with which aid was extended by persons residing within the district. Special acknowledgment should be made to Messrs. A. D. Ewing, J. K. Ewing, A. W. Boyd, and F. H. Oliphant, of Uniontown; Mr. E. D. Pechin, of Dunbar; Dr. H. G. Lomison, of Greensburg, and Mr. L. D. Sherrick, of Mt. Pleasant. From Mr. F. H. Oliphant, Jr., of Pardoe, Mercer county, I received records of shafts and borings made by the Penn Gas Coal Company, otherwise inaccessible. I am under very material obligation to Mr. F. Z. Shellenberg, superintendent for the Westmoreland Coal Company, as he generously placed at my disposal all the results of his extended and elaborate surveys in western Westmoreland county, and furnished also the map showing the area of the *Pittsburg coal bed*, within the line of 10-feet cover between the Pennsylvania railroad and the Youghiogheny river, in western Westmoreland. I only regret that circumstances have rendered necessary the reduction of that map to the small scale on which it is produced in this volume.

Let me here thank you for the elaborate indices prepared for this report and that on the Greene and Washington district. Some of my correspondents state that the index is the best part of the latter report; so I desire to place the credit where it rightly belongs.

The maps accompanying this report show the outlines of the several groups as accurately as the county maps would

permit. The boundary between the Lower Barren and Lower Productive Coal Series, along the face of Chestnut ridge, in Fayette and Westmoreland counties, is in part conjectural. It will be given as clearly as possible in the Part II of this report, to be published in 1878.

The general summary of resources, the discussions of the relations of the anticlinals, of the structure of coal beds, the description of the surface geology, and the lists of fossil remains, which were prepared for this volume, will be submitted with the report for 1877.

Very respectfully yours,

J. J. STEVENSON.

TABLE OF CONTENTS.

PART I.—INTRODUCTION.

	Page.
CHAPTER I. General Physical Features of the District,	1

PART II.—SYSTEMATIC GEOLOGY.

CHAPTER II. Classification of the rocks, . . .	8
CHAPTER III. Anticlinal and synclinal, . . .	10
CHAPTER IV. The Upper Barren Series, . . .	25
CHAPTER V. The Upper Productive Coal Series,	30
CHAPTER VI. The Lower Barren Series, . . .	64
CHAPTER VII. The Lower Productive Coal Series,	73
CHAPTER VIII. The Pottsville (Seral) Conglomerate,	91
CHAPTER IX. The Lower Carboniferous Series, .	96
1. The Umbral rocks. 2. The Pocono (Vespertine) rocks.	
CHAPTER X. The Iron Ores,	110

PART III.—GEOLOGY BY TOWNSHIPS.

CHAPTER XI. Fayette County—	
1. Springhill township, . . .	133
2. Georges township, . . .	143
3. South Union township, . .	151
4. North Union township, . .	161
5. Dunbar township, . . .	176
6. Connellsville township, . .	190
7. Bullskin township, . . .	194
8. Tyrone township, . . .	197
9. Perry township, . . .	202
10. Washington township, . .	207
11. Jefferson township, . . .	209
12. Franklin township, . . .	213
13. Manellen township, . . .	218

CHAPTER XI. Fayette County—*Continued.*

14. Redstone township, . . .	225
15. Brownsville township, . . .	232
16. Luzerne township, . . .	237
17. German township, . . .	241
18. Nicholson township, . . .	248

CHAPTER XII. Westmoreland County—

19. Mt. Pleasant township, . . .	256
20. East Huntingdon township, . . .	265
21. Unity township, . . .	268
22. Derry township, . . .	278
23. Hempfield township, . . .	293
24. Salem township, . . .	311
25 and 26. Loyalhanna and Bell townships, . . .	316
27. Washington township, . . .	325
28. Franklin township, . . .	327
29. Penn township, . . .	331
30. North Huntingdon township, . . .	337
31. Sewickley township, . . .	350
32. South Huntingdon township, . . .	354
33. Rostraver township, . . .	360
34 and 35. Burrell and Allegheny townships, . . .	367

CHAPTER XIII. Eastern Allegheny County—

36. Elizabeth township, . . .	373
37. Versailles township, . . .	380
38. Wilkins township, . . .	383
39. City of Pittsburg, . . .	385
40. Penn township, . . .	387
41. Plum township, . . .	389
42. Patton township, . . .	391

REPORT OF PROGRESS, 1876.

FAYETTE AND WESTMORELAND DISTRICT.

PART I.

INTRODUCTION.

CHAPTER I.

General Physical Features.

The Fayette and Westmoreland district, so far as examined in 1876, includes portions of Fayette, Westmoreland, and Allegheny counties, or that region embraced between Chestnut ridge on the east, and the Monongahela and Allegheny rivers on the west, the northern and southern boundaries being the Conemaugh river and the West Virginia line. Its shape is irregular, and the area is not far from 1,100 square miles.

At first sight, the topography appears to have been determined without regard to any law of arrangement; but the plan is so simple, that a single view from any one of the higher points, on Chestnut or Brush ridge, suffices to show the key to the structure. The whole surface is disposed in a series of benches, more or less disguised by erosion, whereby the details are rendered somewhat perplexing.

The eastern boundary of the district is a bold mountain, known as Chestnut ridge, which rises to somewhat more than 2,800 feet above mean tide.

Brush ridge, running rudely parallel to the last, begins near the West Virginia line, and passes north-north-west through Fayette county into Westmoreland, its crest being about eight or nine miles west from that of Chestnut ridge. Near the center of Westmoreland county, it is divided into Huckleberry and Brush ridges, the former, the less import-

ant, but holding the same relation to Chestnut ridge that the main Brush ridge does in Fayette county. The southern county, therefore, is divided into two areas by this ridge, while Westmoreland is divided into three.

The western valley is that of the Monongahela river, which in northern Westmoreland and Allegheny becomes the valley of the Allegheny river.

The eastern division, that between Chestnut ridge and Brush ridge in Fayette, or Huckleberry ridge in Westmoreland, is now broken into a number of small basins, many of which are broad, handsomely terraced, and covered with a rich soil. The divides between these are usually flat-topped, and, in many cases, are continuations of the main benches seen on the sides and crest of Brush ridge.

A similar condition prevails in the valley lying between Brush and Huckleberry ridges in Westmoreland county.

Of the immediate valley of the Monongahela river, only the eastern side falls within this district, the western side being in the Greene and Washington district, which was examined during 1875. In Fayette and southern Allegheny county, the surface of this valley falls off in a succession of almost parallel benches from the top of Brush ridge until within a distance of somewhat less than three hundred feet above the river, below which the benches are not parallel, but show a slope northward similar to that seen in the present channel of the river. The higher benches are part of the ridge, and form plains of great extent, the chief of them being on the crest, and 1,290 feet above mean tide. Occasional hills rise nearly 60 feet higher.

The gaps made by streams in passing through this ridge are narrow, and inclosed by abrupt walls. In general, the elevation of the surface rises northward, so that in Westmoreland the crest of Brush ridge is somewhat higher than in Fayette.

The drainage is simple, as nearly all of the principal streams flow westward toward the Monongahela or the Allegheny. The chief subordinate systems are those of the Conemaugh (Kiskiminetas) and the Youghiogheny, the former in the northern portion of the district, and the latter em-

bracing the center. In the south, the streams are of only moderate size, and for the most part flow directly into the Monongahela.

The extreme southern part of Chestnut ridge is drained by some streams which empty into Cheat, a large river entering the Monongahela, three miles north from the State line. These, known as Grassy run and Rubbler's run, are of insignificant size, though during flood they carry a large amount of water. Their drainage area is limited, but it contains some fine land.

George's creek enters the Monongahela river at New Geneva, about five miles from the State line. It forms a long narrow valley at the base of Chestnut ridge, and heads at nearly three miles south from the National road. As its larger tributaries come down from the mountain, the creek is important. Unfortunately the supply of water has been so inconstant during late years, that this stream cannot be utilized for power.

Between the mouth of George's creek and that of Redstone, several streams enter the river, all of which head in Brush ridge. None of them except Dunlap's creek, which enters at Brownsville, attains to any size. Their drainage areas are small, and the fall is great. The country drained by them is nearly all cleared, and the surplus of rain-fall is speedily carried off.

Redstone creek heads far up in Chestnut ridge, and receives large tributaries, which in like manner drain much of the mountain slope. Aside from these, some considerable streams come in from the north and north-west, draining the eastern slope of Brush ridge and the almost equally high divide separating this from the waters of Dunbar creek. Between the ridges the area includes North and South Union townships, of Fayette, and the creek flows in a tortuous course near the center. This portion has been seriously eroded, and it is cut up into longitudinal valleys, whose divides rise to 1,200 feet above tide, or nearly 100 feet below the principal plain on the crest of Brush ridge. Through that ridge the Redstone passes by a narrow gap, in which it receives no important tributaries.

Northward from the mouth of Redstone, at Brownsville, no large stream enters the river until the Youghiogheny is reached at McKeesport, in Allegheny county. This river heads in Virginia, cuts through all the principal axes west from the main Allegheny mountain, and drains parts of Virginia, Maryland, and Pennsylvania. Within this district it receives Mount's creek and Dunbar creek from Fayette, Jacobs' creek, and Sewickley creek from Westmoreland, and many smaller tributaries from these counties as well as from Allegheny. South from the river in Fayette the area is marked by gorge-like valleys, showing narrow bottoms. The streams have a rapid fall, and those heading in Brush ridge are soon found flowing on the higher benches.

Mount's creek at the north, entering the river near Connellsville, flows through a more inviting country, and shows broad bottoms nearly all the way from the time it leaves Chestnut ridge. A very high divide separates this from the region drained by Jacobs' creek.

Jacobs' creek, like the Redstone, has eroded a broad and beautiful valley between Brush and Chestnut ridges, which is divided longitudinally by a tongue of one of the higher benches, on which the village of Mt. Pleasant is built. This plain stretches away northward, and at length, curving toward the mountain, becomes the divide between Jacobs' and Sewickley creeks. Through Brush ridge, Jacobs' creek flows in a narrow valley, which rarely expands into bottoms, and the creek enters the Youghiogheny on the line between Fayette and Westmoreland counties. Its drainage area is very extensive, and the stream cuts the axial plane of Chestnut ridge twice, though heading and flowing wholly on the western side of the topographical summit. During flood the stream carries much water, but the fall being great no dependence can be placed on the supply.

Sewickley creek heads in Chestnut ridge, and drains a large area which includes parts of Unity, Mt. Pleasant, Hempfield, East Huntingdon, South Huntingdon, Sewickley, and North Huntingdon townships, of Westmoreland. The conditions east from Brush ridge are the same as those observed on Redstone and Jacobs' creeks, but in Brush ridge

the Sewickley has eroded a broad valley. This is due, no doubt, to the joint action of the main stream and Jack's run, which enters from the north, the two streams uniting at seven or eight miles south from Greensburg. From the junction of the streams the valley narrows, and within two or three miles becomes a close gap, which continues to near the creek's mouth. West from Brush ridge the Little Sewickley enters this. It drains a portion of the Middle valley of Westmoreland.

From the time the Youghiogheny leaves the mountain until it reaches the Monongahela, its channel-way is closely shut in by hills rising from 150 feet to 400 feet above low water, except where some large tributary enters.

Turtle creek is the only important stream entering the Monongahela river, between the mouth of the Youghiogheny and Pittsburg, where the Monongahela and the Allegheny unite to form the Ohio. It drains that portion of Westmoreland and Allegheny counties lying west from Brush ridge, and between the areas of the Youghiogheny and the Conemaugh. This region is large, and the streams show fine bottoms covered with excellent soil.

The Conemaugh river rises beyond the limits of this district in Cambria county, and enters it at the gap in Chestnut ridge.* The drainage area is extensive, and includes all the northern townships of Westmoreland county. Soon after emerging from its gap, at Blairsville, the river receives McGee's run, which drains the eastern part of Derry township, and flows through a fine valley. Further west it is joined by the Loyalhanna, which heads on the west flank of Laurel ridge in the Ligonier valley, and flows through Chestnut ridge in a very impressive gap. It passes through Huckleberry ridge by a narrow gap, and thence runs through the Middle valley of the county. The area is large, and has a diversified surface. The stream carries a great body of water, which is said to be ample for use in running mills at all seasons of the year.

*Below the gap to the Allegheny, this stream was formerly termed the **Kiskiminetas** creek.

The soil of the district is of local origin, and therefore varies according to the nature of the rocks on which it rests.

Limestone, as will be shown in another chapter, is irregularly distributed through the several series of which the coal measures are made up. The Upper Productive Coal Series, which is the richest in limestone, occurs in narrow strips, separated by broad belts, on which only the rocks of the Lower Barren Series are exposed. The difference of soils in these several belts is excessive, and the market value of the former is said to be nearly twice that of the latter. The rich lands resting on the upper coal series yield fine crops of grain, which are by no means so large as they would be, if the soil were not regarded as practically inexhaustible, and therefore needing little or no manure. On the intermediate belts, known as the "Barrens," fair crops of grain can be raised, but the soil is said to be better adapted to grazing purposes. Rich land is found along the Monongahela from the State line to the mouth of the Youghiogheny, for along that whole line the surface rocks belong to the upper productive coal series. Beyond the mouth of the Youghiogheny the soil becomes less rich, being formed mostly from the lean material of the Lower Barren Series.

Chestnut ridge has too abrupt a slope in a large portion of the district to admit of farming, and for long distances it shows little aside from rock. But where the slope is gentler, as in Mount Pleasant township, of Westmoreland county, and in Springhill township, of Fayette county, the surface has been cleared in some cases quite to the top of the ridge. The ground is usually encumbered with fragments of sandstone, but when these have been removed, the soil is found to be as good as that along the ridges in the central portion of the district. The mountain slope will be useful eventually for grazing purposes.

With avenues to market the district is well provided. The Monongahela and Allegheny rivers flow along the western border, and the former, having been slackened, is in good shape for navigation during the greater part of the year. The Allegheny Valley railroad follows the latter

river from Pittsburg to beyond the northern limit of the district, while the West Pennsylvania railroad runs along the Conemaugh to the foot of Chestnut ridge, where it unites with the Pennsylvania railroad. The last crosses Westmoreland and Allegheny counties. From Greensburg, the South-West Pennsylvania railroad runs southward through Westmoreland into Fayette, where it crosses the Youghiogheny at Connellsville and continues southward to Uniontown. The Pittsburg and Connellsville railroad follows the Youghiogheny river and sends off branches to Uniontown, in Fayette, and to Mt. Pleasant, in Westmoreland. Besides all of these, a new road is in progress from Connellsville to Brownsville, on the Monongahela, where it will connect with the Monongahela Valley railroad, now being extended to Brownsville.

PART II.

SYSTEMATIC GEOLOGY OF THE DISTRICT.

CHAPTER II.

Classification.

The stratified rocks, exposed within the Fayette and Westmoreland district, belong wholly to the carboniferous age. In describing them, I shall employ the nomenclature proposed by the Prof. Rogers, for the sake of preserving conformity between this and the report for 1875. This grouping, however, though in accordance with the facts as known at the time it was proposed, is now defective, its inaccuracy having been proved by later investigations.

In the Fayette and Westmoreland district all the groups of the Carboniferous rocks are represented. The Vespertine and Umbral are exposed in the gaps of the Conemaugh, the Loyalhanna, and the Youghioghenny, and in all of these lower rocks are reached which probably belong to the Catskill. The same series are exposed on the National road, where it crosses Chestnut ridge. The Umbral rocks are shown in nearly every hollow along the face of the mountain from the Conemaugh to the West Virginia line. The Pottsville or Seral Conglomerate forms the mountain slope for the greater portion of its length within the district.

The Lower Productive Coal Series comes to the surface along the face of Chestnut ridge as well as along the principal streams under the main anticlinals. The Lower Barrens are the surface rocks in by far the greater part of the area, being exposed along the face of the mountain, as well as on the crests of the chief anticlinals. The Upper Productive Coal Series lies in isolated areas along the central portions of the synclinals, and the Upper Barrens are but sparingly represented. In the Lisbon trough, the full thick-

ness of the *Washington Group* has escaped erosion at a few localities, but, for the most part, only the lower portion of that group is to be seen.

The total thickness of rocks exposed within the district, from the Upper Washington Limestone to the base of the section in the Conemaugh gap, is not far from 2,750 feet. The base of the Catskill has been reached in a salt-boring made near the National road, on the west slope of Chestnut ridge, in Fayette county.

CHAPTER III.

Anticlinals and Synclinals.

Six anticlinal axes were seen within the limits of the district. Like those described in the report for 1875, these do not follow straight lines, but at irregular distances are shifted toward the south-east. The general course is north-north-east and south-south-west.

1. THE LAUREL RIDGE ANTICLINAL.

This bold mountain barely falls within the district, but as it is the eastern boundary of the Ligonier valley, of which a portion was examined, reference to it is made here. This ridge separates Fayette and Westmoreland counties from Cambria and Somerset. No examination was made to determine the exact course of this axis, and that work has been deferred until the detailed study of the Ligonier valley can be completed. Followed southward, it enters West Virginia at the northeastern corner of Preston county, where it is known as McAllister's ridge. Further south it has been confounded with Briery mountain, but that ridge, as was shown many years ago by Prof. W. B. Rogers, belongs to another axis lying further east, while the Laurel ridge axis passes down south-west and lies west from Kingwood. It is the same with that which Prof. Rogers called the Kingwood axis in his report for 1839.

2. THE CHESTNUT RIDGE ANTICLINAL.*

This forms the eastern boundary of the area examined during 1876, and separates it from the Ligonier valley. The name Chestnut hill or Chestnut ridge is applied to it north from the Youghiogheny river but southward from that stream it is known as Laurel hill, so that some confusion is apt to arise owing to the similarity between this

*The Third axis of the Final Report of 1858.

term and that applied to the last axis. To avoid this I have been careful in this report to use Laurel ridge as referring to the second axis and Laurel hill as referring to the southern portion of this.

Within this district the arch of the axis is completely cut by the Conemaugh, the Loyalhanna, and the Youghiogheny. Jacobs' creek, Dunbar creek, and Redstone creek cut very deeply into the arch and the former two really cross the axial plane, though heading on the west side of the topographical summit. The only distinct sidethrow of the axis is near the line of Jacobs' creek, and affects the topography as may be seen by reference to any good map of the State. A similar, though smaller throw seems, from the topography, to exist where the ridge is crossed by the National road, but no positive evidence of it could be found by study of the rocks in the vicinity. Immediately south from the Youghiogheny, the axis curves toward the southwest.

On the Conemaugh the plane of the axis crosses near the two hundred and ninety-eighth mile-post. Here on the crest of the mountain the upper part of the Vespertine or Pocono sandstone stands out in a cliff, while the Umbral rocks and the Conglomerate crop out on each side. On the Loyalhanna the elevation of the fold seems to be fully equal to that on the Conemaugh, but southward to Jacobs' creek the height clearly diminishes, for on that stream the Umbral Limestone is the lowest rock exposed under the axis. Want of absolute levels prevents any determination of the rate at which the fold falls off in this direction; but the flattening must be considerable, for the Conglomerate crosses almost unbroken. In this immediate neighborhood, the axis seems to be thrown off to the south-east, and there certainly appears to be some connection between the sidethrow and the decrease in height.

At the same time there is some room here for doubt, as the nature of this apparent sidethrow. Further south, on Mount's creek, as well as on the Youghiogheny below Connelville, there is a slight anticlinal, which is not far from being in the line which the Chestnut ridge axis would fol-

low were it continued southward for that distance. In like manner, as I have been informed by Prof. Lesley, there is in the Ligonier valley a gentle anticlinal which seems to follow the base of Chestnut hill, and reaches the Pennsylvania Central railroad at Bolivar. This is almost in the line of the axis which I have regarded as the continuation of the Chestnut ridge south from Jacobs' creek. I might be inclined without hesitation to regard the small axis, seen west from Chestnut ridge in Bullskin and Connellsville townships, of Fayette county, as the continuation of the main Chestnut ridge in Westmoreland county, were it not that in Derry township, of the latter county, there is a petty anticlinal, which is imperfectly exposed in some cuttings on the railroad and bears the same relation to the main axis as that of the similarly insignificant axis in northern Fayette county. But that the Chestnut ridge axis is thrown toward the east here, is rendered all the more probable from the fact that all the other axes at the west are thrown off, along a north-west and south-east line, passing almost through the locality where the throw occurs in Chestnut ridge. It would seem probable, therefore, that the main axis has actually suffered a throw at this place, but that the disturbing agency continued to act both north and south along the lines followed by the two portions of the fold. In this way could be explained the existence of the gentle Bolivar anticlinal, and the equally gentle anticlinal of northern Fayette county.

Southward from Jacobs' creek the fold rapidly increases in strength, so that on the Youghiogheny river it is nearly the same as on the Conemaugh, and at the National road it attains its greatest elevation. South from the Youghiogheny, the Umbral Limestone is seen at about two miles from the crest and the Pottsville Conglomerate, forming the slope of the mountain, reaches almost to the valleys, while the rocks of the Lower Productive Coals are barely caught at the base. At the summit on the National road, 2,400 feet above tide, there is seen a curious conglomerate, which, where the axis crosses the Conemaugh, has an absolute alti-

tude of barely 1,250 feet, so that the elevation shows a great increase southwardly.

In the gap of the Conemaugh the extreme dip observed is thirteen degrees, but a few miles south from that line, as I was informed by Prof. Lesley, the rate suddenly increases, so that for a short distance along the crest of the mountain it is almost ninety degrees. Usually, however, between the Conemaugh and Jacobs' creek it rarely exceeds ten to fifteen degrees near the central line of the arch, and from that line in each direction it diminishes irregularly until it becomes only three or four degrees. This decrease is so irregular, that no dependence can be placed on the dip as an aid in determining the thickness of concealed intervals. On Jacobs' creek the sharpest dip seen is eight degrees. Southward from that creek to the National road the dip becomes sharper, and at the latter locality is from fifteen to twenty degrees near the center of the arch, becoming fifteen at a little way from that line and abruptly diminishing to five when the valley of Redstone creek is reached. South from the National road the fold declines. In South Union township the dip is still steep and the Conglomerate forms the slope of the mountain; but in George's the angle is perceptibly less, and as Springhill is approached it becomes so much less that in some places the surface is cultivated quite to the summit, where the Vespertine and Umbral rocks yield a by-no-means inhospitable soil. Along this portion of the ridge the Vespertine rocks are reached only in the deeper hollows, and most of the smaller streams head up in the Umbral strata.

Crossing into West Virginia one finds the ridge showing the same character as far south as the gap of Cheat river, meanwhile, diminishing in height, so that, at that river the Pottsville (Seral) Conglomerate crosses the arch.

3. THE BLAIRSVILLE ANTICLINAL.*

This enters the district near the great bend in the Conemaugh, below Blairsville, crosses the Conemaugh pike near

* The Fourth axis of the Final Report of 1858.

Spruce run, the Loyalhanna near Braeley's old mill, and the Pennsylvania Central railroad at a short distance east from Carr's tunnel. Southward from the railroad this axis cannot be traced, owing to the lack of any definite horizon in the Lower Barren Series to which all the rocks exposed along the line of the fold belong. It certainly disappears before reaching the Sewickley, for along that stream the exposures are continuous and there is no interruption of the easterly dip from the crest of the Saltsburg axis to the bottom of the Blairsville synclinal. At the same time its influence is perfectly distinct at three miles north from that creek and the western dip is well marked. The anticlinal is sufficiently evident for at least four miles south from the railroad, but beyond that it is traceable only with difficulty. In all probability it should be regarded as an offshoot from the great Saltsburg anticlinal, which is the next toward the west.

In abruptness the Blairsville anticlinal diminishes northward, though it loses little in elevation. Its maximum importance seems to be attained on the Loyalhanna where it brings up the *Upper Freeport coal bed*, but in each direction from this locality it seems to diminish. Northward, on the Conemaugh, it fails to bring up the lower coals, as is also the case on the Pennsylvania railroad. Southward from that railroad, its elevation decreases until, near Sewickley creek, this fold is over-ridden by the Saltsburg. Where the axis is clearly recognizable, the dip on each side is sharp, being from two to four degrees, but no appreciable difference exists between the rates on the two sides. The ridge along the course of the Blairsville anticlinal is known as Huckleberry ridge, and is marked by a strip of barren country.

4. THE SALTSBURG ANTICLINAL.*

This is the same with that, which, in my report for 1875, was termed the Fayette county axis. It crosses the Conemaugh at a little distance above White's station, or rather

*The Fifth axis of the Report of 1868.

more than two miles above Saltsburg; the Loyalhanna at James Snodgrass' mill; the Conemaugh pike in the immediate vicinity of Harvey's Five Corners; the Pennsylvania Central railroad near Grapeville station; and the Pittsburg and Greensburg pike near the village of Grapeville. Not far from Little Sewickley creek it is thrown eastward, and is found crossing Sewickley creek near the mouth of Jack's run, almost exactly where the synclinal between this and the Blairsville anticlinal should cross the creek, had there been no change in the direction of the folds. From Sewickley it follows a direct course to Jacobs' creek, which it reaches at about three miles from the Youghiogheny, and thence to the Youghiogheny, which it crosses at the forty-eighth mile post.

On the Sewickley no traces of this or any other fold were seen at or near the locality where the Saltsburg anticlinal would have crossed the creek, but the exposures are not complete along the creek. That some interruption occurs in the dip there is probable, for on the Youghiogheny, above the mouth of Jacobs' creek, there is a slight anticlinal, which is almost exactly on the line of the Saltsburg axis. The condition here is precisely the same as that already referred to in connection with the axis of Chestnut ridge, and shows that, although the axis was thrown off, yet the force continued to act in the original direction for several miles, though with much diminished energy.

At a short distance south from the Youghiogheny river, the axis is again shifted towards the east, for in Franklin township of Fayette county it passes a little west from Flatlands, and crosses Redstone creek near Woods' mill and distillery. Before reaching the National road, it is again deflected toward the east, so as to strike that road just west from the school-house, at three miles west from Uniontown. Thence it follows a direct course, crossing George's creek near Crow's mill, and reaching Cheat river a short distance above its mouth. A slight deflection eastward seems to occur in this neighborhood, for the axis reaches Decker's creek, in West Virginia, above Morgantown.

In Westmoreland county this axis is known indifferently

as Brush ridge and as Grapeville ridge, but in Fayette county the former name prevails. Throughout the district the arch is distinguished by a band of poor soil narrowing toward the south. The hills on each side of the immediate plane of the axis are higher than the surrounding country, and are sufficiently marked to be a feature in the topography.

This fold shows a decided increase of strength northward. Near Morgantown, in West Virginia, it causes little more than an interruption in the dip of the strata as they descend from Laurel hill, and at a short distance further south it is clearly over-ridden by the greater axis. On Cheat river the dip on the east side is barely one third of a degree and on the west side only one degree. On the National road the dip of the *Pittsburg coal bed* at one mile from the axis is about three degrees on the east side and somewhat more on the west side, but at the Youghioghenny the dip on both sides is very nearly four degrees. This rate continues almost to the Pennsylvania railroad, where it is diminished, being only three degrees on the west side and somewhat less on the east. The dip from this line northward shows a constant decrease.

Although the rate of dip evidently lessens northward from the Pennsylvania railroad, yet there is no loss of altitude, for the whole country is raised, and the only result of the slackened dip is that the troughs on each side of the axis become shallower. On Cheat river the *Pittsburg coal bed* crosses the arch and is only 380 feet above the stream or 1,150 feet above the tide. On Redstone creek the *Upper Freeport coal bed* is brought up; on the Youghioghenny the lower coals are exposed, and the *Pittsburg*, if present, would be about 1,400 feet above tide; on the Pennsylvania railroad at the crest of the arch, it would be 1,500 feet; and on the Conemaugh, about 1,600 feet. The interval between the *Pittsburg* and the *Upper Freeport* being taken as 600 feet. Under the arch of this axis, the lower coals are exposed on the Redstone, the Youghioghenny, Jacobs' creek, Big and Little Sewickley, the Loyalhanna, and the Conemaugh.

5. THE WAYNESBURG ANTICLINAL.*

The course of this axis in the Greene and Washington district was given in the report for 1875. It enters the Fayette and Westmoreland district on the Conemaugh very near Roaring run; crosses Pucketta creek almost due west from Oakland post-office; the Conemaugh pike just east from Murrys ville; and the Pennsylvania railroad exactly midway between Carpenter's and Stewart's stations. Beyond that it passes into Allegheny county, but near the Youghiogheny river is thrown eastward into Westmoreland county, and is seen in Sewickley township, where it reaches the Youghiogheny at the big bend in the river, about two miles below the mouth of Sewickley creek; passing through the south-east corner of Elizabeth township, it re-enters Westmoreland county, and, crossing the north-western corner of Rostraver township, reaches the Monongahela river near Webster. It again touches the river near lock No. 4.

This axis has no marked effect on the topography, and the dip on each side rarely exceeds one degree. Like the Saltsburg axis it shows a decided increase northward. Between Ten-Mile creek and lock No. 4 on the Monongahela river it rises 300 feet. The *Pittsburg coal bed* crosses it for the last time in Sewickley township of Westmoreland county. Thence northward, within this district, the arch is marked by a broad band of rocks belonging to the Lower Barren Series. On the Pennsylvania railroad it brings up rocks 460 feet below the *Pittsburg coal bed*, and on Beaver run and the Conemaugh it exposes the Lower Productive Coal Series.

6. THE PIN-HOOK ANTICLINAL.

This, the Seventh axis of the report of 1858, enters the district at the Conemaugh about two miles below Leechburg and follows a direct course to the Monongahela river, which it crosses near the mouth of Patterson's run below Braddocksfield. Its course in the Greene and Washington district is given in the report for 1875. Like the rest it

* The Sixth axis of the report of 1858.

shows a marked increase in elevation northward. The *Pittsburg coal bed* crosses it south from the Monongahela river, but north from that stream the coal occurs only in narrow patches and soon fails to be caught on the crest of the arch.

In the report for 1875, I described the Peter's creek anticlinal as intermediate between the Pin-Hook and the Waynesburg. This was an error. The so-called intervening axis is only the Pin-Hook, which has been shifted eastward here, and the two portions overlap. The Peter's creek anticlinal, therefore, must be erased from the list.

1. THE LIGONIER VALLEY SYNCLINAL.

This is the second great basin of the bituminous coal region west from the Allegheny mountains and south from the Conemaugh river. Throughout its extent in Pennsylvania it is well marked by Laurel ridge on the east and by Chestnut ridge on the west. It is, indeed, the last basin west from the Alleghenies which is well-defined topographically. It extends northward into the region of the lower coals beyond the Conemaugh, and has been definitely recognized in West Virginia as far south as the north-western pike, or about ten miles south from the Baltimore and Ohio railroad. In Westmoreland county, according to Prof. Lesley, a slight anticlinal cuts it, but the disturbance is so slight that it is seen with difficulty.

In Preston county of West Virginia this trough is divided by the Preston axis, which I am inclined to think really extends as a spur from the axis of Chestnut ridge to that of Laurel ridge, so as to join the two axes and to cut off the Ligonier valley. If this view be true, then the trough in which Newburgh, on the Baltimore and Ohio railroad, is situated, would not be the Ligonier valley, but a separate trough between the Preston and Chestnut ridge axes. Whether this be so or not has not been determined by actual observation.

No careful study of this basin was made during 1876, as the trough lay without the proper limits of the district, and examination was made only of the limited area in West-

moreland county containing the *Pittsburg coal bed*. The exposed rocks within the basin belong to the lower series, except on a few high hills along the dividing ridge between the Conemaugh and the Loyalhanna.

2. THE BLAIRSVILLE SYNCLINAL.

The whole of Pennsylvania, lying west from Chestnut ridge and south from the Conemaugh and Ohio, was included in Prof. Rogers' third basin west from the Alleghenies. Of this basin the trough, which I have called the Blairsville, is the first sub-division in Prof. Rogers' list. It has Chestnut ridge as the eastern boundary. North from Sewickley creek the western boundary is the Blairsville axis, but southward from that line, as the Blairsville is merged into the Saltsburg anticlinal, the latter is the western limit to the southern end of the trough. From the Conemaugh to the Youghiogheny the basin shows little variation in width, but thence to Decker's creek, in West Virginia, it gradually narrows, and in the vicinity of that stream it disappears. The axis enters the district on the Conemaugh almost due south from Blairsville; crosses the Pennsylvania railroad at Loyalhanna station; passes through the village of Pleasant Unity, and crosses the South-West Pennsylvania railroad barely one mile south from Tarr's station. Not far from the last locality it is evidently deflected eastward, but the erosion is so extensive that the precise point where it crosses Jacobs' creek could not be ascertained. It crosses the Youghiogheny, at the deep shaft, nearly midway between Connellsville and Broadford, the Redstone at Uniontown, and the Cheat river near the Line ferry. It attains its greatest depth near the Youghiogheny, and becomes shallower north and south from that line. On Cheat river, near the bottom of the trough, the *Pittsburg coal bed* has an elevation of about 1,030 feet above tide; at Uniontown that bed is not far from 700 feet above tide; on the Youghiogheny, somewhat less; on the South-West Pennsylvania railroad, 1,070 feet; on the Pennsylvania railroad at Loyalhanna, it is somewhat less than 1,000 feet, and on the Conemaugh the elevation is not far from 1,000 feet.

The influence of the Blairsville anticlinal in deepening the trough is seen on the Pennsylvania railroad and the Conemaugh.

This basin is of great economical importance, as it holds an extensive body of the *Pittsburg coal bed*, which is divided into several areas by the Youghiogeny and the Conemaugh rivers. The details respecting these areas will be found in the general description of the *Pittsburg bed*. As that bed, within this basin, yields a coal too soft for shipping, but admirably adapted for coking, the basin is commonly known as the coke basin. Along the central line, the hills in many places rise to a great height, and there are several such hills in Dunbar township of Fayette county, whose summits are fully 600 feet above the Youghiogeny river, at Connellsville.

3. THE GREENSBURG SYNCLINAL.

This, the second sub-division of the third basin south of the Conemaugh and Ohio, lies between the Blairsville and Saltsburg anticlinals. Its axis enters the district near the tunnel at the horse-shoe bend of the Conemaugh; crosses the Loyalhanna about a mile below New Alexandria and the Pennsylvania railroad, just east from the tunnel at Greensburg. South from the railroad the trough can be traced only for four miles, beyond which it is abruptly cut off by the eastward shifting of the Saltsburg anticlinal. Like the other basins it shows a decided elevation northward, so that the *Pittsburg bed*, which at Greensburg is about 250 feet below the track, is far above the Loyalhanna at New Alexandria, and north from that village soon runs out in the hills.

In this trough a large and compact body of the *Pittsburg coal bed* is caught, but the basin is not very deep, and no rocks belonging to the Upper Barren Series are shown.

4. THE LISBON SYNCLINAL.

This is, in part, the third sub-division of the third basin, and lies between the Saltsburg and Waynesburg anticlinals. In the detailed portion of this report it is called the Lisbon

(Irwin) Synclinal. It enters the district nearly three miles below Saltsburg on the Conemaugh; passes through Salem township at a little north from school-house No. 1; crosses the Conemaugh pike in Franklin township, about a mile west from New Salem, and the Pennsylvania railroad at a few rods east from the Westmoreland company's shaft, near Manor station. Near the line of Little Sewickley creek it is shifted eastwardly to correspond with the Saltsburg anticlinal, and reaches Sewickley creek above Markle's mill, about two thirds of the way to Bell's mill. It crosses the Youghiogeny river near Port Royal station, and continues thence in a straight line to Little Redstone creek, which it crosses near the Red Lion post-office in Jefferson township of Fayette county. Not far south from this it is again shifted eastward, and crosses Redstone creek at Parkhill's mill; Dunlap's creek at about a mile below the line of Manellen township; Middle run in German township, at a mile from the Monongahela river, which it crosses at nearly a mile from the mouth of Middle run. Its course in Greene county was given in the report for 1875.

Like the others, this basin shows a marked rise northward. At the bottom of the trough on the Monongahela river the *Pittsburg coal bed* is barely 500 feet above tide; at the Youghiogeny it is somewhat more than 650 feet; on the Pennsylvania railroad, 750 feet; while at the final out-crop north from the Conemaugh it is upwards of 1,000 feet. This is an exceedingly deep trough, and the change in altitude is much more gradual than in the others. The whole of the Washington Group of the Upper Barren Series is caught in it at several localities within the district, and the *Pittsburg coal bed* reaches further north than even in the Blairsville trough, there being a large and economically important area of that bed north from the Conemaugh river.

As the *Pittsburg coal bed* is mined extensively at Irwin on the Pennsylvania railroad within this basin, I have thought well to designate this by the double title of the Lisbon (Irwin) Synclinal, so that its relations may be readily understood by those who may have frequent occasion to consult the detailed portion of this report. This double title,

however, is employed only for convenience in describing the geology of the townships, so that in other portions of the report the axis will be mentioned as the Lisbon.

5. THE WAYNESBURG SYNCLINAL.

This lies between the Waynesburg and Pin-Hook anticlinals. Its axis enters the district about two miles below Apollo, on the Conemaugh; passes through Allegheny and Burrell townships, and crosses Pucketta creek where that stream first becomes the boundary between Allegheny and Westmoreland counties. It crosses the Pennsylvania railroad near Turtle Creek station, where it is marked by an abrupt bend in the creek. Beyond that point to the Monongahela river its course was not minutely traced, but like the other axes, both anticlinal and synclinal, it is shifted toward the east, for it crosses the Monongahela river at Monongahela City. Its course thence through Washington and Greene counties was given in the report for 1875.

The rise northward is more marked in this trough than in any of the others yet described. At Huston's station, on the Monongahela Valley railroad, the Pittsburg coal bed is 740 feet above tide; at Turtle creek station it is nearly 1,000 feet; at a few miles north from the railroad the coal is in small areas on top of the higher hills; while in northern Allegheny and in Westmoreland county only a few straggling areas remain, and these are barely of local value.

6. THE NINEVEH SYNCLINAL.

This lies between the Pin-Hook and Washington anticlinals. The eastern side is found in Allegheny and Burrell townships of Westmoreland county. In Allegheny and Westmoreland counties this trough is exceedingly shallow, so that it contains none of the *Pittsburg coal bed* in the latter and only patches of that bed in the former. The axis crosses the Monongahela near Monterey. Owing to imperfect exposure and the want of accurately leveled lines, the course of this axis could not be made out.

VARIATIONS IN DIP.

By many mining men dip is supposed to be regular, and "swamps" or local reversals, to be exceptional, so that the owner of land on which they occur is apt to regard himself as peculiarly unfortunate. These ideas are erroneous, for the dip, in the very nature of things, cannot be continuous in any direction for any considerable distance, though for several miles a prevailing dip will always be found.

The sides of a synclinal are made up of many petty anticlinals and synclinals. The similarity of these small folds to the greater ones, which include them, is so marked that the two sets must have a common origin.

There seems to be a common belief that the most available locality for a shaft is on the central line of the synclinal, since there a single pump will drain a great area on both sides of the trough. This erroneous sentiment is likely to entail disappointment and loss. There is no central line of drainage. Almost without exception I have found that along the middle of the trough there runs a subordinate anticlinal, in some cases very slight, but always large enough to interrupt the drainage in each direction. The axis of the synclinal follows the crest of this little anticlinal. In some cases the central portion of the trough is thrown into a succession of crumplings, so that if a shaft should be sunk very near the central line it may bring the owners to a series of bad "swamps." As a rule, it may be stated that there is no possibility of finding a line of central drainage for the whole basin.

Ignorance of this condition has led to unjust reflections upon the ability of engineers who have been employed at great expense to determine the exact place of the synclinal axis. After the line had been determined and the shaft sunk, it was discovered that the drainage is imperfect on one or all sides, and the engineer received blame for carelessness or incapacity, whereas the fault was not his, and the failure was due to the fact that the strata do not lie as was supposed. In addition to this it should be remembered that the line of strike in the troughs is not on water level,

for along that line there is in all the synclinals a steady rise northward, so that, even were there no subordinate anticlinals, the water would necessarily follow any workings carried toward the south-south-west. The rise northward and its practical effects are well shown in the extensive mines of the Wesmoreland Coal Company at Irwin, in Westmoreland county, where, in order to retain a low grade, the main entries follow quite closely the line of water level. They enter almost in the direction of strike, but the course gradually changes, until, at length, it is nearly at right angles to that adopted at the mouth of the entries.

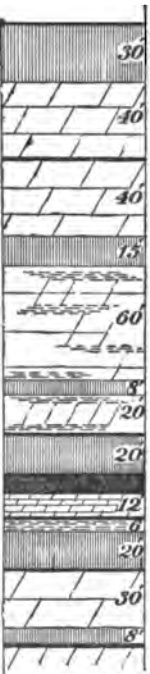
CHAPTER IV.

The Upper Barren Series.

Owing to the shallowing of the synclinals northward and to the gradual uplifting of the whole basin in that direction, as well as to the increased erosion eastward, the Upper Barren Series is poorly represented in this district. The Greene county group is wholly wanting, and the Washington county group is shown only at rare localities. Exposures throughout are very bad, and no connected section of the series could be obtained, so that for the benefit of those who may not have access to the report for 1875, the section of the Washington group is reproduced here from that volume:

Section of the Washington County Group.

Fig. 1.

1. Coal or shale, . . .		1'
2. Up. Wash. L. S., VI,	30'	30'
3. Sandstone,	40'	40'
4. Jolleytown coal bed,	1'	1'
5. Sandstone,	40'	40'
6. Middle Washington limestone, IV, . .	15'	15'
7. Sandstones and sha.,	60'	60'
8. Limestone, III, . .	8'	8'
9. Sandstones and sha.,	20'	20'
10. Carb. sh. or coal bed,	1'	1'
11. L. Wash. L. S., II, .	20'	20'
12. Washington coal bed	10'	10'
13. Sandstone,	12'	12'
14. Little Wash. coal bed	1'	1'
15. Shale,	6'	6'
16. Limestone, 1 b, . .	20'	20'
17. Waynesb. 'b' coal bed	1'	1'
18. Sandstone,	30'	30'
19. Limestone, 1 a, . .	8'	8'
20. Waynesb. 'a' coal bed	2'	2'
21. Waynesb. 'g' s'dstone,	—	—
Total,	Washington County Group.	238'

In the Blairsville synclinal only the lower rocks belonging to this group are reached, and they are usually concealed. The *Waynesburg* "a" is caught by the high hills in Mt. Pleasant township, of Westmoreland, and in Bullskin, of Fayette, but it was not found exposed. In Dunbar and North Union townships, of Fayette, it is shown, and is very thin. A coal bed holding the place of the *Washington* was once worked in Dunbar, about two miles north-west from Mt. Braddock.

The Greensburg and Waynesburg Synclinals do not catch any of the rocks belonging to this series.

In the Lisbon synclinal, rocks belonging to this group occur even to the last area of the Pittsburg coal bed at the north, though the upper portion of the section is reached at but few localities.

Within this trough the Upper Washington Limestone has been identified, with some hesitation, on Sheplar's knob, in Rostraver township of Westmoreland county, where it is 100 feet above the *Washington coal bed*. In Indiana county, at 80 feet above the bed which I have identified with the *Waynesburg coal*, there is a limestone, which can be no other than the Upper Washington, though, owing to the absence of sections connecting this area with the others at the south, the identification is not complete. In the eastern portion of Redstone township of Fayette county a high hill, seen at a little way north from the National road, should catch this limestone; for at some distance below its summit, and at 360 feet above the *Waynesburg coal bed* there is a massive sandstone precisely like that so often mentioned in the report for 1875 as underlying the limestone. Fragments of the limestone were seen on Dunlap's creek, above Merrittstown.

The *Jolleytown coal bed* was found in Redstone township of Fayette county, on the National road, west from Mr. Colley's residence, where, near the summit of a high knob, its blossom is exposed underlying the sandstone just referred to. It occurs also on the ridge nearly a mile north-east from that place. No other exposures were found.

The great Middle Washington Limestone has disap-

peared. Its place is exposed at several localities within this district, but no traces of the rock were seen. Limestone III was observed only in Redstone township, at two localities on the National road, and at both the exposure is so incomplete that the thickness of the bed cannot be determined. The rock is ferruginous and shows dark patches on the weathered surface. Elsewhere throughout the district its place, when reached, is concealed. In Fayette county, the Lower Washington Limestone was seen in German township, on Mr. Struble's property, and in Redstone township, on Dunlap's creek, above Merrittstown. At both localities the exposure is imperfect, and the thickness of the bed was not ascertained. In Westmoreland county this stratum was seen in Rostraver and South Huntingdon townships, where it varies from 6 to 10 feet, and is an excellent limestone. In general character it is the same in both counties.

The *Washington coal bed* was seen in German, Redstone, Luzerne, Jefferson, and Washington townships of Fayette, and in Rostraver and South Huntingdon of Westmoreland. Beyond doubt it is present in Sewickley and North Huntingdon of the latter county, though it was not seen, and the limestone quarried on the pike south from Shafton station may be the Lower Washington. In Fayette county this coal is no longer mined, and the only opening seen, at which measurement could be made, is that belonging to Mr. A. Struble, in German township, where it shows :

Coal,	0' 4"	} 4' 10"
Clay,	1' 3"	
Coal,	1' 1"	
Clay,	0' 6"	
Coal,	0' 11"	
Clay,	0' 5"	
Coal,	1' 2"	

Between the coal and the limestone above there is a deposit of iron ore. The quantity seems to be considerable, and its quality is shown by the following analysis. (A. S. McCreath) :

Carbonate of iron,	10.564
Carbonate of Manganese, . . . . .	.749
Alumina,	2.578
Carbonate of Lime,	61.132
Carbonate of Magnesia,	1.459
Sulphuric acid, . . . . .	.867
Phosphoric acid, . . . . .	.066
Carbonaceous matter, . . . . .	.370
Insoluble residue,	21.405
	<hr/> 99.190

As may be seen by reference to the report for 1875, this is an ore-bearing horizon, but in the greater portion of the Lisbon trough the quantity of ore is too inconsiderable to be of economical importance.

In Westmoreland county the *Washington coal bed* shows the same characters as in Fayette, but at some localities it attains to much greater thickness. An opening in South Huntingdon township shows an extreme thickness of nine feet, and the bed is made up of alternating layers of slate and slaty coal. In both counties the variations in thickness are abrupt, so that within a short distance the bed may change from a few inches to several feet. Everywhere the coal is inferior, so that even where the bed is thickest it is mined to but a limited extent. Practically it may be regarded as worthless.

The *Little Washington coal bed* was observed at but one locality, though its place is frequently exposed.

Limestone I "b" is wanting. Limestone I "a" was seen near the Christian chapel, east from Brownsville, on the National road; also on Dunlap's creek, above Merrittstown, but at no other locality in Fayette county. It is far from being persistent in this county, for the *Waynesburg "a" coal bed* was frequently seen with sandstone directly above and below it. In Westmoreland county this limestone is persistent, being frequently exposed in Rostraver and South Huntingdon townships. Its extreme thickness is five feet, and the rock is always quite ferruginous.

The *Waynesburg "a" coal bed* is persistent throughout the trough, having been seen wherever its place was exposed. It was found in Redstone, Jefferson, and German, of Fayette; in Rostraver and South Huntingdon, of Westmore-

land ; as well as in North Union and Dunbar, of Fayette, and Mount Pleasant, of Westmoreland, in the Blairsville trough. It is always thin, and rests almost directly on the Waynesburg sandstone. No openings in it were seen:

CHAPTER V.

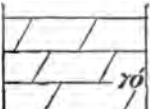




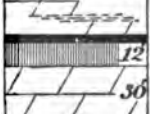







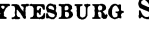
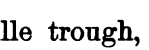
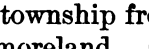
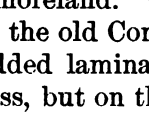
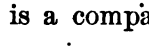
The Upper Productive Coal Series.

The rocks belonging to this series occur in every trough within the portion of the district examined during 1876, and small outlying areas are found in the Ligonier valley of Westmoreland county and in the Salisbury basin of Somerset county. Some notes on the Ligonier and Salisbury areas are given in this chapter, but the detailed description of the latter will be found in the report on Somerset county for 1876 by Messrs. F. & W. G. Platt; the references made to it in this report are merely incidental, introduced, in part, for the sake of presenting a general view of the whole series west from the Alleghanies and, in part, for the sake of removing some erroneous impressions to which I have contributed.

A definite generalized section of the Upper Productive Coal Series cannot be given, owing to great variations in the intervals. For the most part, however, the more important members of the group are persistent in by far the greater portion of the areas, so that a section representing the series in its extreme development will be ample for the purpose here, while sections showing the local variations will be found in reports upon the several townships in which the rocks of this group occur. It will appear from an examination of these sections that intervals between the beds diminish quite regularly northward in each trough, and that a similar diminution occurs westward from the Lisbon trough. The nature of this variation will be shown in another portion of this report.

The section of the Upper Productive Coal Series is as follows:

Fig. 2.

1. Waynesburg sandstone, . . . . .		. . . . . 70'
2. Waynesburg coal bed, . . . . .		. . . . . 6'
3. Sandy shale or s'dst.		. . . . . 20'
4. Little W'sburg coal		. . . . . 2'
5. Waynesb'g limest'e,		. . . . . 20'
6. Shale and shaly sandstone, . . . .		. . . . . 50'
7. Uniontown coal bed		. . . . . 3'
8. Uniontown limest'e		. . . . . 12'
9. Sandstone, . . . . .		. . . . . 30'
10. Lower Division of Great Limestone,		. . . . . 80'
11. Sewickley coal bed, .		. . . . . 3'
12. Sandstone, . . . . .		. . . . . 30'
13. Fish-pot limestone, .		. . . . . 25'
14. Shale or shaly sandstone, . . . . .		. . . . . 20'
15. Redstone coal bed, .		. . . . . 4'
16. Redstone limestone,		. . . . . 10'
17. Sandstone or shale,		. . . . . 40'
18. Pittsburg coal bed,		. . . . . 12'
Total,	<i>Upper Coal Series.</i>	. . . . . 437'

THE WAYNESBURG SANDSTONE.

Within the Blairsville trough, this sandstone was observed in almost every township from South Union, of Fayette, to Unity, of Westmoreland. On the Morgantown road in South Union and on the old Connellsville road in North Union, it is a thin-bedded laminated sandstone, very soft and altogether worthless, but on the old Pittsburg road in the latter township it is a compact rock, showing ripple

markings on the exposed surfaces. This is the constant character at all the northern exposures.

In the Greensburg trough, the sandstone was not recognized. It is probably present, but the section, which is given in detail in the description of Hempfield township, is such that one is not justified in making positive identifications of rocks above the great limestone.

In the Lisbon trough, the Waynesburg sandstone was recognized in every township from German, of Fayette, to Sewickley and Hempfield, of Westmoreland, but beyond the latter, northward, the identification is somewhat indefinite, owing to thinning of the intervals and disappearance of the limestones. At the south, it is commonly compact below and flaggy above, but at some localities on the river bluffs in German and Luzerne townships, the whole mass forms cliffs of solid sandstone, most of which is well fitted for building purposes. Northward it becomes shaly, and in Westmoreland county cannot always be recognized as a sandstone. In the southern portion of the Lisbon trough this rock is from 65 to 70 feet thick. In south-western Westmoreland the interval between the *Waynesburg* and *Waynesburg "a" coal beds* has almost the same thickness, but it is not wholly occupied by sandstone, the upper portion always containing more or less shale.

Between the sandstone and the *Waynesburg coal bed* there is often a shale, the same with that described in the report for 1875. In German and Redstone townships, of Fayette county, it contains numerous impressions of plants which, for the most part, are not well preserved. This shale is far from being persistent, and the sandstone at many localities rests directly on the coal.

THE WAYNESBURG COAL BED.

This bed is thoroughly persistent, being found wherever its horizon is reached and exposed. In the Blairsville trough, it is shown in South and North Union and Dunbar townships, of Fayette, as well as in Mt. Pleasant and Unity, of Westmoreland, and its blossom was seen in Derry town-

ship, of the latter county. In the southern portion of this trough the bed is very thin, seldom more than two feet, but in both Mt. Pleasant and Unity it is from four to five feet thick. It has been mined in Mt. Pleasant, but nearly all of the openings have been deserted, owing to the poor quality of the coal. The bed is caught only in patches on the higher hills along the center of the trough.

In the Greensburg basin, the *Waynesburg bed* has not been recognized, though the thin bed seen on the road from Greensburg to Alexandria may be its representative.

In the southern portion of the Lisbon trough, the *Waynesburg coal bed* is the principal source of supply in German, Luzerne, Brownsville, and Redstone townships, of Fayette county. Occasional openings were seen in Jefferson, of the same county, but in the adjoining townships of Washington and Manellen, the bed is too thin to be of any economical importance whatever. It is usually triple, and in general bears a close resemblance to the same bed as described in the report for 1875. The benches and partings show abrupt variations in thickness, so that the profit of mining is always a doubtful quantity. The following is a fair section of the bed as seen in Brownsville township:

Coal,	1' 6"	} 5' 6"
Clay,	0' 1"	
Coal,	1' 5"	
Clay,	0' 5"	
Coal,	2' 1"	

In Redstone township, near the creek of that name, the bed shows an additional bench, and the section is as follows:

Fig. 3.

Coal,	0' 4"	} 10' 5"
Shale with Iron Ore,	5'	
Coal,	0' 4"	
Clay,	0' 2"	
Bony Coal,	0' 4"	
Coal,	1' 8"	
Clay,	0' 2" to 6"	
Coal,	2' 5"	

Waynesburg O.

Throughout this portion of the trough the bony layer is a
3—KK.

common feature. Occasionally it is a cannel of fair quality, but for the most part it is a worthless bony coal, which can be burned only with difficulty. The partings vary at the expense of the coal, usually cutting out the overlying layer. At some localities, in Redstone and Luzerne townships, the bottom bench becomes four feet thick.

In Westmoreland county, the *Waynesburg coal bed* is commonly too thin to be of any value. In Rostraver and South Huntingdon it never exceeds three feet, but the coal is said to be of excellent quality. In North Huntingdon it is barely three feet, and is looked upon as worthless. Its blossom was seen in Hempfield township, south from Adamsburg. This seems to be the coal bed opened by Mr. Smith on Elder's ridge, north from Saltsburg, in Indiana county, and near the northern out-crop of the Pittsburg coal bed.

The analyses show that the coal from this bed in Fayette county is similar to that obtained in Greene county, so that it is not likely to become of value except for local use, where access to the Pittsburg or some other bed is difficult.

Underlying the *Waynesburg coal bed*, there is usually a sandstone or sandy shale, which is sometimes sufficiently good for building purposes, though ordinarily it is in thin layers, and can be used only for flagging.

THE LITTLE WAYNESBURG COAL BED.

In Greene county, a black shale was commonly seen resting on the Waynesburg Limestone, but at no locality did it become a coal bed. In Fayette county, within the Lisbon trough, a well marked coal bed often occupies this place, and is sufficiently persistent to be placed in the section. This I have called the *Little Waynesburg coal bed*. On Brown's run, in German township, it is two feet thick, and yields good coal. Near Parkhill's mill, on Redstone creek, it is somewhat thicker, and is said to consist of excellent coal. Within the Blairsville trough, and at all localities in Westmoreland county, where its horizon is exposed, it is merely a black shale. This bed was not recognized either as coal or black shale in the Greensburg basin.

THE WAYNESBURG LIMESTONE.

In the report for 1875, this is called a local limestone, an error unintentionally inserted during the preparation of sub-headings. The rock is local in the sense that every limestone of the series is local, but at the same time it is one of the most persistent of the whole series, being found in all the troughs within this and the Greene and Washington district, excepting the Ligonier and possibly the Greensburg. In thickness it varies from eight to thirty-five feet, and everywhere yields a lime of superior quality.

In the Blairsville trough it was seen, wherever its horizon was reached, in all the townships from Georges, of Fayette, to Derry, of Westmoreland. Throughout it is thin, rarely exceeding six feet. The only localities where it is wanting are in the immediate vicinity of Uniontown, where it seems to have been cut out previous to the deposit of the overlying sandstone. References to it will be found in the descriptions of south and north Union townships, of Fayette, and of Mt. Pleasant, Unity, and Derry townships of Westmoreland.

The Waynesburg limestone has not been satisfactorily identified in the Greensburg trough, though possibly one of the higher limestones of the railroad section obtained in Hempfield township, may be the representative of this stratum.

In the Lisbon trough, it is persistent throughout, but it is not exposed in Sewickley township of Westmoreland county. In German, of Fayette, it occurs on nearly all of the streams in the west and north-west portions of the township, and attains the great thickness of 35 feet on a tributary to Brown's run. In Luzerne township it seldom exceeds 8 feet, while in Washington the only exposure observed showed but 4 feet. On Redstone creek, between Franklin and Redstone townships, it is from 15 to 20 feet, but in Jefferson and Washington townships it is thin. Passing over into Westmoreland county one finds it 10 feet in Rostraver, 7 feet in South Huntingdon, 5 feet in Hempfield and North Huntingdon, and 7 feet 6 inches in Penn township. No

further exposures of it were found within Westmoreland county northward, but this seems to be the limestone exposed on Elder's ridge, near the extreme outcrop of the Pittsburgh coal bed.

The Waynesburg Limestone is not caught by any of the hills in the Waynesburg or Nineveh trough within this district. These basins rise so rapidly that they hold only small patches of even the *Pittsburg coal bed*.

Between the Waynesburg Limestone and the *Uniontown coal bed* the rocks are only sandstone and shaly sandstone. The sandstone of this interval rarely becomes of any value except at Uniontown, where it is a flaggy rock, which has been quarried for flags.

THE UNIONTOWN COAL BED.

The *Uniontown coal bed* rests directly on the upper division of the *Great Limestone*, and attains its chief importance in the vicinity of Uniontown, Fayette county. There it is a double bed, somewhat more than 3 feet thick, but it is not mined, owing in part to the inferior quality of the coal, and in part to the proximity of the *Pittsburg coal bed*. At Uniontown it has a thin blue limestone almost directly overlying it, but this is not persistent, for even within the borough, it is found wanting, and the flaggy sandstone rests on the coal. The bed in the Blairsville trough seems to retain its thickness almost to the Youghiogheny river; but beyond that northward to the final outcropping, it is thin and is traced with difficulty, owing to its insignificance as well as to the increased erosion, whereby sections of length sufficient to reach this coal are rare, and do not afford data for satisfactory identification of the upper rocks.

In the Greensburg trough this bed has not been identified.

In the Lisbon trough it is persistent at least as far north as the Pennsylvania railroad. Beyond that line northward, it has not been recognized in borings or at exposures. The bed is of irregular thickness, and seems to be valueless at all exposures.

THE GREAT LIMESTONE.

In the report for 1875, this was described as consisting of two divisions, there termed the *Lower* and the *Upper*. This description was sufficiently accurate for the Greene and Washington district, but in Fayette and Westmoreland counties it does not apply in detail. Here the upper is distinct, but the lower division is sub-divided at most localities within the Blairsville and Greensburg basins. In order to prevent confusion and to retain conformity between the two reports, the mass will be described as consisting of two principal divisions.

Upper Division of the Great Limestone.—This, which in some portions of this report I have referred to as the *Uniontown* limestone, is persistent in the Blairsville trough, certainly as far north as the southern boundary of Unity township, of Westmoreland county. At Uniontown, it is a compact rock in two layers, with a total thickness of 10 feet, and is manufactured into cement, which seems to be of good quality, as it is used at the government works on the Monongahela river. Elsewhere in the vicinity the rock varies from 6 to 10 feet. It is well exposed in Georges, North and South Union, and Dunbar townships, of Fayette. Few exposures were seen north from the Youghiogheny river, until the southern boundary of Mt. Pleasant township, of Westmoreland, was reached, whence to Pleasant Unity, in the southern portion of Unity township, the exposures are quite frequent.

In the Greensburg basin I could not distinguish this from the main mass of the Great Limestone. It is no doubt present as one of the higher limestones seen in the railroad section of Hempfield township.

In the Lisbon trough this is a marked stratum, being readily identified at least as far north as the southern border of North Huntingdon township, of Westmoreland. Beyond this, northward, it disappears, and along the Pennsylvania railroad the interval between the *Uniontown* coal and the lower division of the Great Limestone is greatly lessened. In German, Luzerne, Redstone, Manellen, Frank-

lin, Jefferson, Washington, and Perry townships, of Fayette, this upper limestone is constantly present, as also in Rostraver, South Huntingdon, Sewickley, and the southern portion of North Huntingdon townships, of Westmoreland. It varies from 6 to 15 feet in thickness, though in the vicinity of Brownsville it seems to be almost wanting. The quality is as variable as the thickness; sometimes the bed yields a lime of excellent quality, at others it is worthless, while again it produces a very fair cement.

Between the Uniontown and the Lower Division of the Great Limestone there is sandstone varying in thickness with the increase or decrease of the Lower Division. Occasionally the interval contains some shale, and at a few localities a black shale was seen resting on the Lower Division. In the vicinity of Uniontown this shale is very rich in carbon and is almost a cannel coal.

Lower Division of the Great Limestone.—This is persistent in all the troughs, where the hills are high enough to catch it. In the Blairsville basin it was seen in all the townships from Georges at the south to Derry at the north, being almost the whole length of the upper coal area. It was not seen in Springhill, of Fayette, as erosion has removed all of the upper coal series from the eastern side of the basin, and on the western side has taken away all rocks above the *Sewickley coal bed*, except at one locality between Morris Cross-Roads and Cheat river. But in Monongalia, of West Virginia, near the southern extremity of the trough, the limestone is exposed on a high ridge separating Cheat and Monongahela rivers. It is greatly reduced in thickness, and is represented only by some thin ferruginous layers, which are very earthy, and have a total thickness of barely 8 feet. In southern Fayette county it is badly broken up at many places, one section in South Union township showing four strata, with 42 feet of limestone in 87 feet of measures. A similar condition appears in North Union, but in Dunbar the layers seem to have been consolidated, for on the Dunbar company's property the thickness exposed at one quarry is 55 feet. Some of the layers are very good, but, for the most part, the rock is siliceous or

argillaceous, and in each case, so much so as to be worthless for use at the furnace. Followed into Westmoreland county this limestone rapidly thins out within the Blairsville trough, so that it is barely 20 feet in Mt. Pleasant and Unity, and 18 inches in Derry, where it is seen for the last time.

In the Greensburg basin one finds, beginning at 170 feet above the *Pittsburg coal bed*, six strata of limestone, showing 61 feet 6 inches of limestone in 146 feet of measures. For the most part, these are ferruginous and more or less argillaceous, so that many of them would doubtless make a good cement, but are worthless for burning into ordinary lime. The interval above the *Pittsburg* is so great, that clearly not all of these can belong to the Lower Division, and the group must include also the Uniontown and Waynesburg limestones. Owing, however, to the absence of the higher coal beds, the relations of the upper limestones could not be determined with any degree of accuracy.

In the Lisbon trough, this portion of the limestone attains its greatest thickness, and is persistent to the last exposure of the upper coal group. At the same time it becomes thinner northward, and in that direction beyond the Pennsylvania railroad it rapidly loses its importance, and its thickness becomes subject to great and sudden variations. The numerous sections along the Monongahela given in the report for 1875, sufficiently show the character of the rock in the southern portion of this basin. At Brownsville it is little less than 70 feet thick, at the Youghiogheny, near the line between Fayette and Westmoreland counties, it is shown to the thickness of 55 feet, while on the Sewickley at Markle's mill it is more than 70 feet. Northward from the Sewickley it diminishes. In the Youghiogheny shaft of the Penn Gas Coal Company, south from Irvin station on the Pennsylvania railroad, it is 15 feet. Along the railroad the variations are abrupt, being 12 feet in a cut near Shafton, $7\frac{1}{2}$ feet in the Westmoreland company's shaft near Manor station, and 28 feet in a cut between the cut and the station. In a boring made north from the railroad by the Westmoreland company, it is about 20 feet thick. Beyond

this northward to the Conemaugh it was not seen, but north from that river, in Indiana county, it appears near the final outcrop of the *Pittsburg coal bed*, where it is evidently very thin.

On the Pennsylvania railroad and in its vicinity this limestone is known as the 120-foot-limestone, there being nearly that interval between it and the *Pittsburg coal bed*, in the Westmoreland company's shaft on the railroad. But as may be seen by reference to the sections given in the description of Penn and North Huntingdon townships, of Westmoreland county, the interval in no case is so large as 120 feet. North from Sewickley creek the limestone is very ferruginous and for the most part worthless. It shows as great variations in quality as in thickness, as might be expected near its disappearance. The last of this bed, as a continuous mass, may be regarded as occurring within five miles north from the Pennsylvania railroad.

THE HIGHER ROCKS IN THE LIGONIER VALLEY AND THE SALISBURY BASIN.

In the Salisbury basin a persistent limestone, varying from 10 to 12 feet in thickness, occurs at 155 feet above the *Pittsburg coal bed*, and another, closely resembling it in appearance and associations is found at from 85 to 90 feet above the same coal. Both limestones are found at all places within the area, where the surface rises high enough to take them in, and their horizons are exposed. Between the limestones there are two coal beds. The lower one rests almost directly on the lower limestone, and is persistent as far as the limestone can be followed. The upper one is very thin but its blossom was seen at several places. On the upper limestone is a coal bed which in this basin is co-extensive with the limestone. A section of this top coal as exposed on property belonging to the Keystone Coal Company is

Coal,	0' 10"	} 3' 3"
Clay,	0' 1"	
Coal,	2' 4"	

Here it is separated from the underlying limestone by about 3 feet of clay and shale. At the northern end of the

basin this coal shows the same structure, but is thinner, being only 2 feet 2 inches.

In the report upon Somerset county (HHH) Messrs. F. and W. G. Platt have identified the upper one of these limestones as the Great Limestone, and regard the overlying coal as the *Uniontown coal bed*. They identify the lower limestone with the Fishpot or Sewickley Limestone, and the thin coals between the limestones are thought to represent the *Sewickley coal bed*. These little coals are included in a considerable mass of black shale, a condition common in the western troughs. The interval between the *Uniontown* and *Sewickley coal beds* here is only 65 to 70 feet, while in the southern portion of the Lisbon trough it is 120 to 140 feet.

These limestones are quarried and yield good material. It should be noted that in this the Great Limestone of the Salisbury basin differs from the same rock in the other troughs, where it usually is a cement rock.

In the Ligonier valley the Great Limestone is represented by two beds, which are caught in the higher hills, holding the small areas of the Upper Coal Series, in Ligonier and Fairfield townships, of Westmoreland county. They are thin, 25 feet apart, are of good quality, and are used for burning into lime. The lower ore is 160 feet above the *Pittsburg coal bed*, so that both of them represent the higher portions of the mass. It is unfortunate that no detailed section of the series could be obtained in the Ligonier valley, since such a section would doubtless aid much in determining the relations of the Salisbury rocks.

THE SEWICKLEY COAL BED.

In the Salisbury basin a widely persistent coal seam, about four feet thick, occurs at not far from 45 feet above the *Pittsburg coal bed*. At the extreme southern end of the basin an exposure shows the bed as follows :

Coal,	0' 2"	} 4' 1"
Clay,	0' 2"	
Coal,	0' 6"	
Clay,	0' 1"	
Coal,	2' 3"	
Clay,	0' 9"	
Black Clay,	0' 2"	

Near the northern end of the basin the same bed is found at the same distance above the *Pittsburg coal bed*, and is five feet thick. At one time, I was inclined to think this the *Sewickley coal bed*, but the Messrs. Platt, with good reason, think it may be identified with the Redstone. This bed seems to be persistent in the Salisbury basin, but evidently is not looked upon as of much economical value.

In the Ligonier valley no coal bed was seen which could be regarded as equivalent to the *Sewickley*. The whole section, between the Great Limestone and that which I have regarded as representing the Fishpot Limestone, is concealed, but I could learn from no one respecting any coal or coal blossom between these limestones. If the bed were present here it should show some traces.

In the Blairsville basin, the *Sewickley coal bed* is persistent from the southern limit of the trough in Monongalia county, of West Virginia, to Derry township, of Westmoreland county. In Georges, Springhill, North and South Union, Dunbar, and Connellsville townships, of Fayette, this bed is usually of workable thickness, varying from four to five feet. South from the Youghiogheny, it is known as the Five-Foot Seam. In the extreme southern part of the district, as well as in the peninsula between Cheat and Monongahela rivers, in West Virginia, the bed has suffered degradation from sub-aerial erosion before the deposition of the over-lying rocks, for there it is little more than 1 foot thick. This condition prevails within West Virginia, but in this district it is confined to a narrow space, in Springhill township, of Fayette. The bed shows no well-defined or persistent partings, but is marked by many thin layers of shale, which add to the ash and diminish the value of the coal. Northward from the Youghiogheny, the bed becomes thinner, so that in Mt. Pleasant township it is only 18 inches, but at one locality, in Unity township, it is increased to nearly 4 feet. Beyond this, northward the bed becomes insignificant, so that in the southern part of Derry township it varies from 2 feet to less than 6 inches, and at many places is only a carbonaceous shale. This bed finally disappears, at

no great distance north from the Pennsylvania railroad, in Derry township.

Within this basin, the *Sewickley coal bed* is separated from the Great Limestone above by from 25 to 40 feet of shale or shaly sandstone, and rests almost directly on the Fishpot Limestone. A similar condition exists at the southern portion of the Lisbon trough, within this district, in both Springhill and Nicholson townships, of Fayette, but northward in that trough the over-lying shale becomes very thin, and the thin shale seen below it in the Blairsville trough becomes thick, so that the coal lies almost immediately below the Great Limestone.

In the Greensburg trough, this bed is identified with some hesitation. At 132 feet above the Pittsburgh a coal bed was seen in a railroad cut east from Greensburg, as well as at numerous other localities within Hempfield township. The section as exposed in the railroad cut is as follows:

Carbonaceous shale,	0' 5"	}	3' 4"
Coal,	1' 5"		
Clay,	1' 0"		
Carbonaceous shale,	0' 6"		

The coal in this bed is inferior, and is much broken by layers of slate. The bottom shale is so rich in carbon as to be a fair cannel. In respect of structure this bears some resemblance to the *Sewickley* as it appears at many localities. It is of no value at any locality within this basin.

In the Lisbon trough the bed is easily traced as far north as to Sewickley creek, but beyond that it was not recognized. In the southern portion of the district it is quite thick, and is mined in Nicholson and German townships of Fayette county. Northward, it becomes so irregular as to be of little value. Sometimes it is merely a black shale, while at others it is a thin coal bed. At Brownsville, on the Monongahela river, it is absent, but on Redstone creek, only three miles away, it is present, while on the river hills, barely two miles off, the bed is of workable thickness. The workable bed on the pike west from West Newton, and that on Sewickley creek, have been confounded with this bed. The works there are on the *Redstone coal bed*. The

Sewickley is seen on the West Newton pike and on Sewickley creek at but few localities, and at nearly all is represented by a carbonaceous shale, resting directly under the great limestone, and sometimes so rich as to be an inferior cannel coal. The variations in thickness within this basin are as follows: In Nicholson township, 3 to 5 feet; on Redstone creek, from 10 inches to two feet; In Perry township, on the Youghiogheny river, 3 inches; in Rostraver township, of Westmoreland, the same; on Sewickley creek, about 2 feet. Beyond this northward the bed was not identified. The quality of the coal is Nicholson and German townships is shown by the following analysis (D. McCreath:)

Water,	1.060
Volatile comb. matter,	34.805
Fixed carbon,	53.538
Sulphur,	2.452
Ash,	8.165
	<hr/>
	100.000
Percentage of cooke,	65.135
Color of ash,	Gray, with pink tinge.

The sample analyzed was obtained in Nicholson township, about two miles and a half south from the village of Masontown.

In the Waynesburg and Nineveh basins this bed was not recognized. Its horizon is rarely reached, and, when the hills are high enough to catch it, they are covered by a thick coating of debris.

THE FISHPOT LIMESTONE.

In the Salisbury basin one occasionally finds below the *Redstone* a limestone which, by error, I identified with the Fishpot. The Messrs. Platt identify it with the Redstone Limestone. According to the survey by Mr. Sanders, this limestone is of uncertain occurrence, having been seen by him at only two localities. At the southern end of the basin it appears at Mr. Beechey's opening in the *Pittsburg coal bed*, where it is not far from 10 feet thick, and shows the *Redstone coal bed* resting on it. Mr. Sanders states that he saw the same limestone at a locality several miles

away at the northwest, but there its thickness is not shown, nor is the overlying coal bed exposed.

In the Ligonier valley, a limestone is found at from 26 feet to 47 feet above the *Pittsburg coal*, which in all probability is the Fishpot Limestone. It is persistent at all localities within the limited areas of the upper coals, where its horizon is reached. Its quality is poor and but little use is made of the rock, most of the lime used in this region being obtained from the higher limestones.

In the Blairsville trough, the Fishpot limestone is separated from the *Sewickley coal bed* by but a few feet of more or less sandy shale. At the southern end of the basin, near to and beyond the State line, it is thin and inferior, but northward it grows thicker and improves in quality, so that in North Union township, of Fayette, it is quarried for use as flux. In Dunbar township, of the same county, it is irregular, and on the Dunbar company's property seems to be wanting. Northward from the Youghiogheny river, its occurrence is uncertain, the rock being present at some localities and absent at others in the immediate vicinity of the last. Its final disappearance northward is on the Pennsylvania railroad, at a short distance west from St. Clair station, in Derry township of Westmoreland. Here, on the east side of the trough, it is 1 foot thick, but on the west side it is absent at all localities where the horizon is exposed.

In the Greensburg basin, this is probably represented by the limestone seen on the railroad, in Hempfield township, at 60 feet above the *Pittsburg coal bed*, and having in all a thickness of 20 feet, the calcareous shale being included. It is a wretched ferruginous rock, and is utterly valueless.

In the Lisbon trough, the relation of this limestone to the *Sewickley coal bed* varies. Toward the southern portion of the trough there intervenes between the coal and the limestone only a few feet of sandy shale, which occasionally disappears, and the coal rests on the limestone. This is the case at New Geneva. On Cat's run, only four miles further north, the interval is 15 feet, occupied by sandy shale. On Redstone creek, above Brownsville, the distance between

the two strata is 30 feet, containing a sandy shale and flaggy sandstone; while on the Youghiogheny river, near the line of Westmoreland county, the coal is 20 feet above the limestone, and separated from it by ordinary shale. This limestone is persistent on the east side of the trough, from the southern limit of the basin northward into South Huntingdon township, of Westmoreland, but it disappears before reaching Sewickley creek, and cannot be recognized north from that stream. On the west side it disappears before reaching the Youghiogheny river, and is not found in Ros-traver township, of Westmoreland. At New Geneva, it is 10 feet thick, and so ferruginous that it is not employed for any purpose. On the Redstone, it is 30 feet thick, and here, as well as in German township, it is of such excellent quality, that it is the chief source of lime for all purposes. On the Youghiogheny, within Fayette county, it is barely 10 feet, and very impure, but somewhat further north, in South Huntingdon township, of Westmoreland, it becomes fully 20 feet, and is largely a limestone of great purity.

In the Waynesburg trough, the Fishpot Limestone was not seen. North from the Pennsylvania railroad, the hills rarely rise high enough to catch it, and when they do the limestone seems to be absent. In the more southern portions of this trough, within Allegheny county, the limestone seems to be wanting, as it certainly is further south, in Washington county, as was shown in the report for 1875.

In the Nineveh trough, the hills are not high enough to reach this limestone, but sufficient is known, from observations in the southern part, to show that it disappears before reaching the Monongahela river.

THE REDSTONE COAL BED.

The occurrence of this bed in the Salisbury basin has been mentioned elsewhere. In the Ligonier Valley it may be represented by a little coal bed, 2 to 3 feet thick, and from 17 to 32 feet above the *Pittsburg*, which is persistent in Ligonier township, of Westmoreland county.

In the Blairsville trough, it seems to be persistent from the southern limit to Derry township, of Westmoreland. In

West Virginia, just south from the State line, it is nearly 4 feet thick, and is thought to be of some economic importance, though it is not mined. On Georges creek, it is for the most part only a carbonaceous shale, but on the waters of Redstone it is a coal bed varying from 6 to 18 inches. On Dunbar and the Youghiogeny, it seldom exceeds 10 inches, but northward, on the waters of Jacobs' creek, it becomes thicker, and is known as the 4-foot coal bed, though it is rarely more than 3 feet. On Sewickley creek, it is represented only by bituminous shale, but further north, in the vicinity of the Pennsylvania railroad, it is again a coal, and varies from 6 to 10 inches.

In the Greensburg basin, this bed can hardly be identified with any degree of certainty. It is probably represented by the small bed shown on both sides of the basin, at from 10 to 18 feet above the *Pittsburg*. On the east side, this coal is very thin, and of no economic value whatever, but on the western side, it sometimes becomes 3 feet thick, and is mined.

In the Lisbon trough the *Redstone* is persistent either as coal or as carbonaceous shale, to a long distance north from the Pennsylvania railroad. In the vicinity of Georges creek, it is a carbonaceous shale, approaching cannell in appearance, and usually about 4 feet thick. On Redstone creek it shows one foot of coal near Brownsville, and is absent at a short distance up the creek. In Washington township, of Fayette, along the river, it is 2 feet, but in Perry township, on the Youghiogeny river, it is 4 feet. In Westmoreland county this bed is 4 feet on the Youghiogeny, about the same on the Sewickley, but northward from the latter stream it becomes thinner, and is known as the 3-foot coal bed, near the Little Sewickley. Near the Pennsylvania railroad it is from one to three feet, and is of little or economical importance. It was last recognized at the north on the Freeport road in Washington township, of Westmoreland county. In the vicinity of the Pennsylvania railroad this is known as the 80-foot coal bed, that being nearly the interval between it and the *Pittsburg* in the Westmore-

land company's shaft, near Manor station. The interval is much less than that at the north.

This bed is mined in Washington and Perry townships, of Fayette, and in Mt. Pleasant, Rostraver, South Huntingdon, and Sewickley townships, of Westmoreland. The coal is usually of fair quality, not very sulphurous, but it contains a large percentage of ash. The bed is difficult to mine, as it is much broken by horsebacks and clay veins, some of which are of grievous size. The clay veins are frequently 6 to 10 feet wide, and the horsebacks often cut out fully two thirds of the coal.

In the Waynesburg trough the *Redstone coal bed* was found only in the southern portion near the Monongahela river, in Allegheny county. It may be present further north in that county, but, if so, it is concealed. The hills in the Westmoreland portion of this trough are not high enough to catch the bed. In the Nineveh trough it is not caught within the district, and only in Peebles township, of Allegheny township do the hills rise high enough to reach it. Whether or not it is present there cannot be determined, as the higher hills are deeply covered with debris.

THE REDSTONE LIMESTONE.

When present, this directly underlies the *Redstone coal bed*. It is rarely present in the Salisbury basin, but is persistent in the Blairsville trough. In the last it is a ferruginous, but otherwise, usually pure rock. In Monongahela county, of West Virginia, it is thin, as it is also on the waters of Georges creek. But on the waters of Redstone, and thence northward to the Youghiogheny river, it is thick, and is quarried for use as flux at the furnaces. Northward from the Youghiogheny it becomes irregular and impure. At some localities it is wholly wanting, though within a short distance it is present in imposing thickness. In East Huntingdon township, of Westmoreland this rock is so ferruginous that it might be regarded as a calcareous iron ore. On the Pennsylvania railroad it has degenerated into a calcareous shale, containing nodules of limestone. Beyond this line northward it is wanting.

In the Greensburg trough this limestone is not present.

In the Lisbon trough the observations, though numerous, are not sufficient to determine the conditions of its occurrence. On the eastern side of the trough it is absent at New Geneva, present on Brown's run, wanting on Redstone, very largely developed in the vicinity of the Youghiogheny, beyond which northward it becomes very irregular and seems to occur in patches. Sometimes it is altogether absent, at others it is represented by a calcareous shale, while again it is a well-marked limestone. It was seen for the last on the Freeport road, north from New Salem, in Salem township, of Westmoreland county. On the west side of the trough it is absent on the Redstone, and Little Redstone, on the Youghiogheny and on Sewickley, but appears near the Pennsylvania railroad, where it shows extreme variations, such as have been mentioned in the descriptions of the other limestones. North from that railroad it soon disappears. Throughout this trough it is a ferruginous limestone.

In the Waynesburg and Nineveh troughs, it was not seen. It is certainly absent from the former, as it does not occur in Washington county. Respecting its existence in the latter, nothing is known since on the west side of the Monongahela river its place is concealed, and on the east side it is not caught by the hills.

THE INTERVAL BETWEEN THE REDSTONE AND PITTSBURG COAL BEDS.

Within the Fayette and Westmoreland district this interval varies from 10 to 116 feet, and is occupied, aside from the Redstone limestone, by sandstones and shales. In the Blairsville basin, however, a remarkable variation occurs, which extends from the central portion of North Union township, of Fayette, to the Youghiogheny river, and does not wholly disappear until the Pennsylvania railroad is reached, in Westmoreland county. On the National road the interval is barely 50 feet, but on the property of the Dunbar furnace company the following section was obtained.

4—KK.

		Fig. 4.	
1. Redstone coal bed,		.....	1'
2. Clay, . . . . .		.....	1'
3. Redstone limestone,		.....	10'
4. Shale, . . . . .		.....	20'
5. Coal bed, . . . . .		.....	4'
6. Clay, . . . . .		.....	3'
7. Limestone, . . . . .		.....	2'
8. Shale, . . . . .		.....	25'
9. Coal bed, . . . . .		.....	1'
10. Shale and sandstone		.....	50'
11, Pittsburg coal bed,		.....	16'
Total . . . . .		.....	133'
		Dunbar.	

No. 5 is a good coal, and is mistaken for the *Sewickley*, which, near the Youghiogheny, is reduced in size and is quite slaty. It was seen on the Dunbar property, and near Mt. Braddock, on the road leading to Mr. Beeson's house. Northward I have been unable to trace it. This bed certainly disappears before reaching the Lemont furnace property, in North Union township, of Fayette. The limestone associated with it is very impure, and far from being as persistent as the coal bed.

The lower coal of the section is practically a rider to the *Pittsburg*, and the interval between these two beds varies from 10 to 50 feet. This fact causes perplexity respecting the relations of the sandstone so often found overlying the *Pittsburg coal bed*.

At Connellsville and at numerous other localities, a thin coal bed is seen at a few feet above the *Pittsburg*, which has been mistaken for the *Redstone*. Still further north, on the Pennsylvania railroad, one frequently sees under the sandstone above the *Pittsburg* the remains of what was once a continuous coal bed. One of these fragmentary exposures occurs at Beatty's station, on the Pennsylvania railroad, and is described under Derry township, of Westmoreland county. In the Lisbon trough a thin coal bed is occasionally exposed at from 10 to 13 feet above the *Pittsburg*, and is often found in the borings made by the coal companies of Westmoreland. Where it is absent its place is commonly occupied by a carbonaceous shale. This I am much inclined to regard as being the same with the lower

coal of the Dunbar section. At the same time no means exist whereby the question may be finally answered, for one cannot trace out the beds, owing to lack of connection between the several basins. Even in the troughs themselves the covering of debris is so thick that for long distances the only means of tracing is the blossom of the *Pittsburg coal*, and the character of even the rock immediately overlying that bed cannot be determined.

In the report for 1875, I described a massive sandstone, which, in the Greene and Washington district, seems to be persistent, or nearly so, immediately above the *Pittsburg coal bed*. This I called the Pittsburg sandstone, using the name given to it by Prof. H. D. Rogers nearly forty years ago. In this district a sandstone is commonly found overlying the *Pittsburg coal*, and separated from it by only a few feet of shale. There is, however, much doubt in my mind respecting the accuracy of the conclusions which would regard the sandstones at all localities as one. If the little coal bed at Dunbar be the same with that seen on the railroad just below Connellsville, respecting which there seems to be no room for doubt, and this the same with that seen on the Pennsylvania railroad near Beatty's station, as well as in the coal shafts near that railroad in the Lisbon trough, then it is utterly impossible for the heavy compact sandstone seen at Dunbar and other localities southward to be the same with that seen on the Pennsylvania railroad in the vicinity of Latrobe and St. Clair, in the Blairsville trough, or at Penn and Irwin, in the Lisbon trough, for those sandstones overlie the little coal bed.

The interval between the *Redstone and Pittsburg coal beds* is variable both in thickness and in the character of its rocks. In the Blairsville trough, on the National road, it contains, aside from the Redstone limestone, only shale, but about midway there is some black shale, which may represent the little coal of the Dunbar section. Further north there is a mass of compact sandstone, 45 feet thick, and directly overlying the coal. This is well shown at Lemont and is present at Dunbar, though there it has a tendency to become shaly. In the southern portion of Westmoreland

county this interval contains only sandstone below the Redstone limestone, while north from the Pennsylvania railroad, where the limestone has disappeared, the rock is a sandy shale. On the Conemaugh there is a sandstone over the coal and separated from it by a few feet of shale, but this is clearly a different rock from that observed further south, for the whole interval between the *Redstone* and *Pittsburg* has disappeared before the river is reached.

In the Greensburg trough this interval is filled by sandy shale.

In the Lisbon trough it is filled by sandy shale at New Geneva, where the interval is but 25 feet; on Cat's run the rocks are sandstone and sandy shale; at Brownsville there is sandy shale, with some layers of plant-bearing clay shale interstratified, and the whole thickness is but 25 feet; on the Youghiogeny it consists below the Redstone limestone of sandy shale with a little flaggy sandstone. In Westmoreland county it contains flaggy sandstone to the outcrop.

Sandstone overlies the *Pittsburg coal bed* in the Waynesburg and Nineveh troughs.

THE PITTSBURG COAL BED.

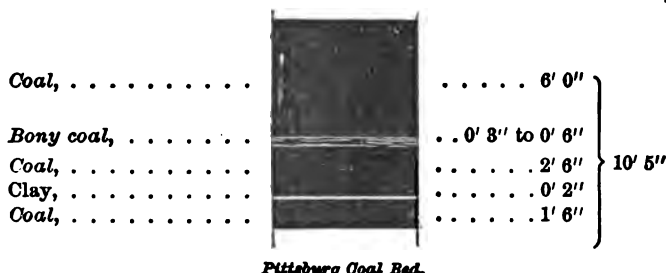
Unlike the other coal beds of the series, the *Pittsburg* is not only persistent throughout the district wherever its horizon is exposed, but it varies within such narrow limits that it is of workable thickness at all exposures. The extent of the areas which it underlies is given on the maps, and minute details respecting its distribution and outcrop line are given in the descriptions of the various townships in which it occurs.

In the western troughs this is invariably a double bed, but this characteristic is wanting or practically so east from the Blairsville basin.

The Salisbury Basin.—In this basin the area of the *Pittsburg coal bed* is limited to a small space near the Maryland line. The coal, in respect both of structure and quality, bears much resemblance to that from the same bed in the Frostburg field, where it is extensively mined and shipped

as the Cumberland coal. The Salisbury area, though small, is important, as the *Pittsburg* attains to great thickness, and is so readily accessible, that every bit of marketable coal can be removed. The structure of the bed varies to such an extent that a section obtained at one pit is not to be duplicated at any other. Perhaps the best section is that shown at the works of the Keystone Coal Company, which is as follows:

Fig. 5.



The three benches of the section are persistent in these works, but at the Cumberland company's mines the section is different. At one place in these mines the three benches are seen, having the respective thicknesses of 66, 13, and 7 inches, while the clays are 15 and 3 inches, but the usual section here shows five benches, 24, 13, 22, 18, and 6 inches, with clay partings 1½, 1, 1, and 3 inches. The coal obtained in this basin has less volatile combustible matter than that from the Ligonier valley, as that, in turn, has less than that from the Blairsville and other troughs at the west. Its nature is fully shown by the analyses given in Mr. Platt's report on Somerset county.

In this basin the coal may be regarded as single since at at none of the northern exposures is there a roof division present. At the same time one can hardly doubt the existence of that division, for at the southern end of the area, at the Beechey bank, a coal bed, 4 feet thick is seen at 1 foot above the *Pittsburg*. This bed, at the Wilhelm mine is 6 feet above the *Pittsburg*; at the Keim mine, 12 feet, and at the Graham mine, 18 feet, these localities being nearly north from the first. Northward from the Gra-

ham mine, this upper coal bed was not seen, but it may be represented by the black shale overlying the *Pittsburg* at some openings in the northern part of the area. At one time I regarded this as the same with the coal which I have already identified with the *Redstone*, but the careful topographical survey made by Mr. Sanders seems to render the former identification uncertain, so that for the present the 4-foot bed may be regarded as a purely local offshoot from the *Pittsburg*, to disappear within three or four miles or beyond that, to be represented only by some doubtful black shale.

The Ligonier Valley.—In this valley the *Pittsburg* coal bed is single or rather the division is so indistinct that it would not be perceived by one unacquainted with the bed in the western basins. The roof division, so persistent in the western troughs, is represented in the Ligonier valley only by a more or less carbonaceous shale, seldom more than 1 foot thick and rarely containing any coal. In the lower division, which alone is present here, there is a separation into benches much like that in the Blairsville basin, but the general condition is transition from that seen in the Salisbury basin to that observed in the Blairsville trough. At the extreme northern exposure of the bed the section is:

Coal,	2' 8"	} 7 6½"
Parting,	0½"	
Coal,	1' 10"	
Parting,	0½"	
Coal,	3' 0"	

Here the roof shale is wholly absent, but at less than half a mile away it is present, 6 inches thick, and contains thin streaks of coal. The bed at the latter opening is in five benches, of which the upper two represent the top bench of the other pit. Usually, however, in this basin the bed consists of three benches, separated by well-defined partings. The top bench is tender but bears handling well, yet not well enough to be a good shipping coal. The middle bench has a prismatic structure and is so friable that in many places the prisms can be separated by the fingers. The bottom bench is harder than the others but is a soft,

friable coal. The first and second benches clearly represent the upper or breast coal of the western troughs, and in some openings the bearing-in is found.

The following analyses show the character of the coal :

I. T. S. Seaton's pit, Ligonier township. (A. S. McCreath.)

II. R. R. Cauffield's pit, Fairfield township. (A. S. McC.)

Water,	0.580	1.050
Volatile comb. matter,	24.850	25.170
Fixed carbon,	64.779	69.602
Sulphur,	3.496	0.668
Ash,	6.295	8.510
	100.	100.
Percent. of coke,	74.570	73.780
Color of ash,	Red.	Red.

The Blairsville Trough.—Along the center of the Blairsville trough the *Pittsburg coal* is found from the southern termination of the basin to beyond the Conemaugh river, in Indiana county. The field is broken by Cheat river, Jacobs' creek and the Conemaugh, but is continuous under Redstone, the Youghiogheny and the Loyalhanna. Southward the basin tapers and so rises as to throw the coal far up in the hills, but in the peninsula between Cheat and Monongahela rivers there is an important area, as some of the hills rise to fully 600 feet above the rivers, and afford excellent cover for the coal. This area, lying in both Pennsylvania and West Virginia, and well placed for ready access to good shipping facilities, will eventually be of much value as all of the coal can be obtained without shafting and at little expense for drainage. In the southern portion of this area, the bed is single and somewhat reduced in thickness, owing to erosion during the deposition of the overlying sandstone. North from Cheat river the bed is usually double, showing the roof and lower divisions as described in the report for 1875. The following table shows the character of the bed in the different portions of the trough. The first column gives the roof division, the second, the main clay parting, the third, the lower division, and the fourth the amount of coal in the roof division :

	TOP COAL.	MAIN CLAY.	BOTT'M COAL.	
Springhill township, of Fayette county,	4' 0"	0' 6"	8' 6"	1' 6"
Georges township,	4' 0"	2' 6"	9' 1"	1' 10"
North Union township,	0' 0"	0' 0"	8' 4"	0' 0"
Dunbar township,	5' 1"	1' 0"	9' 0"	3' 7"
Connellsville township,	5' 1"	1' 0"	8' 1"	3' 7"
Mt. Pleasant township, of Westmore-				
land county,	4' 10"	0' 8"	8' 9"	4' 4"
Unity township,	0' 6"	1' 0"	7' 11"	0' 6"
Derry township, on Pennsylvania rail-				
road,	0' 4"	1' 0"	6' 8"	0' 4"
Derry township, on Conemaugh river, .	0' 3"	1' 3"	6' 1"	0' 3"
— township, of Indiana county, . .	1' 11"	0' 10"	6' 7"	0' 7"

In rare cases the roof division is absent, but this condition is characteristic of only a small area in the immediate vicinity of the National road, where the general structure closely resembles that observed in the Ligonier valley, and the carbonaceous matter of the roof is disseminated throughout several feet of shale. A curious feature is the increase of coal in the roof northward to the southern line of Westmoreland county, and its decrease thence to the outcrop in Indiana county. This is different from the condition found in the Greene and Washington district, where only the more western troughs are reached.

Within this basin the lower division does not always show the separation into well-defined benches so characteristic of it in the troughs at the west, and in this respect it resembles the Ligonier condition. The distinction between the upper and bearing-in benches is rarely lost, except in the southern portion of the basin, but the brick and lower bottom benches cannot always be distinguished. In southern Fayette the bed shows a tendency to divide still further, and so many thin slates occur that one is at a loss to make out the benches with certainty. Sometimes the upper bench is triple, and in a large part of the whole area there is a well-marked parting of clay or bony coal at from 27 to 30 inches from the main clay. Toward the north the bed becomes thinner, and the benches are for the most part better defined.

In this basin the coal is soft and frequently exhibits a prismatic structure. At most of the pits barely one half of

the coal is brought out in lump size fit for shipping, and of this a large part is reduced to slack during transportation. The lower half of the bed is ordinarily softer than the upper portion. Owing to the softness of the coal, it is converted into coke. The following analyses show the character of the coal. They are arranged so as to show the changes northward.

I. Swan Heirs' pit, North Union township, Fayette county.
(D. McCreath.)

II. L. Beal, Manellen township. (D. McC.)

III. G. Chambers, Unity township, Westmoreland county.
(A. S. McCreath.)

IV. Mr. Anderson, Unity township. (A. S. McC.)

V. Dr. H. G. Lomison, Derry township. (D. McC.)

VI. Millwood Coal Company, Derry township. (A. S. McC.)

	I.	II.	III.	IV.	V.	VI.
Water,	0.980	1.020	1.140	0.880	0.880	1.240
Volatile comb. matter,	33.710	31.840	29.880	31.720	31.030	30.715
Fixed carbon, . . .	59.391	61.844	62.227	61.072	62.819	63.799
Sulphur,	0.909	0.736	0.668	1.143	0.746	0.621
Ash,	5.060	4.560	6.085	5.185	4.575	3.625
	100.000	100.000	100.000	100.000	100.000	100.000
Per cent. of coke,	65.360	67.140	68.980	67.400	68.140	68.045
Color of Ash, . .	gray-red	gray.	gray-red	red-gray	cream.	red-gray

On looking at some of the openings in southern Fayette, one would be inclined to think the coal too poor for coking, owing to the evident presence of sulphur and slate. The partings are not very thin and seem to consist wholly of clay; but the small percentage of ash shows that they must consist largely of mineral charcoal. Nearly all of the sulphur is found in these partings. On the Pennsylvania railroad and northward the coal is apparently inferior, and at Latrobe and Coketon, it must be washed before coking, though at Loyalhanna that process has not yet been employed. The coke obtained after washing is not thought to be equal to that made in the southern portion of the basin. The cause of this inferiority is not shown in the results of the analysis.

Within the Blairsville basin the coal is very regular, and there are few troubles to annoy the miner. Clay veins seldom occur, and such as were seen are of insignificant size. Horsebacks are equally insignificant, and most of those which have been found, cut away only the top foot of the bed, which is not an inconvenience, as that amount of coal must be left to support the otherwise not altogether secure roof. The chief grievance comes in the shape of swells in the underclay, which sometimes cut out the lower half of the bed and extend for many yards.

The Greensburg Trough.—In this basin the coal area is small, but compact, and the variations in the bed are not excessive. The two divisions are persistent, and the four benches of the lower division are distinct at all the openings. The following measurements are given as showing the full extent of variation, the arrangement being the same as in the Blairsville table.

	TOP COAL.	MAIN CLAY.	BOTT'M COAL.	
Hempfield township, west side,	4' 10"	1' 6"	7' 10"	2' 1"
Hempfield township, east side,	0' 4"	0' 6"	7' 8"	0' 4"
Salem township,	2' 5"	1' 2"	7' 7"	1' 5"
Derry township,	0' 6"	1' 0"	6' 0"	0' 6"

The roof division is thin on the east side, but always quite thick on the west side of the basin. In the lower division the upper bench or breast coal is usually unbroken, but at some of the pits on the east side one finds a trace of the parting, which in the Blairsville trough divides this bench nearly midway. The coal in the Greensburg basin is harder than that of the Blairsville, but is too tender to be a good article for shipping; while for gas-making it is inferior to that from the Lisbon trough. The following analyses show the character of the coal here:

- I. Mr. Horner, Salem township. (A. S. McCreath.)
- II. W. Seanor, Derry township. (A. S. McC.)
- III. Greensburg Coal Company, Hempfield township. (A. S. McC.)

	I.	II.	III.
Water,	1.200	1.010	1.020
Volatile comb. matter,	33.600	32.980	33.495
Fixed carbon,	58.491	62.962	61.844
Sulphur,	0.794	0.788	0.861
Ash,	5.915	2.260	3.280
Per cent. of coke,	100.	100.	100.
Color of Ash,	65.200 cream.	66.010 cream.	65.485 r'd'h-g'y

The Lisbon Trough.—Here the *Pittsburg coal bed* shows those characteristics, which, in the report for 1875, I regarded as especially distinguishing it. The field is continuous under the Monongahela river, and under-runs the Youghiogheny and the Sewickley creek as well as the Pennsylvania railroad; but northward from the last line it is broken by almost every stream which crosses the trough, and the coal occurs only in patches. In this basin the coal is carried north beyond the Conemaugh, and an important area is seen in Indiana and Armstrong counties. The following list of measurements shows the variations of the bed in the Lisbon trough, the arrangement being the same as in previous tables:

	TOP COAL.	MAIN CLAY.	BOTT'M COAL.	
Nicholson township, of Fayette county,	6' 0"	0' 10"	8' 2"	1' to 3"
German township,	4' 0"	0' 5"	8' 3"	2' to 10"
Brownsville township,	0' 4"	0' 6"	9' 0"	0' 4"
Franklin township,	3' 0"	0' 8"	7' 0"	2' 1"
Perry township,	2' 0"	0' 8"	7' 0"	2' 0"
Rostraver township, of Westmoreland county,	2' 11"	1' 0"	8' 10"	2' 0"
South Huntingdon township,	2' 8"	1' 0"	7' 5"	2' 0"
Sewickley township,	4' 0"	0' 10"	5' 10"	3' 0"
North Huntingdon township,	2' 1"	1' 0"	6' 6"	1' 11"
Penn township,	3' 0"	1' 3"	6' 0"	3' 0"
Salem township,	2' 0"	0' 10"	7' 8"	1' to 2'
Loyalhanna township,	3' 0"	1' 0"	8' 6"	2' to 3'
— township, of Indiana county, .	2' 3"	0' 8"	7' 1"	1' 8"

An examination of this series, which is as nearly an average as one can make, shows that there is no uniformity in the thickening of the roof division northward, nor is there in that direction any material increase in the amount of its

coal. Here as in all the other troughs the roof coal is worthless.

I have said that the lower division here shows the four benches already described as characterizing the bed in the western basins. This statement is accurate for the greater part of the trough, but at the south, in Nicholson and Springhill townships, of Fayette, where the Lisbon and Blairsville portions unite by crossing the Saltsburg axis, the bed changes gradually, so that at length on the fold the structure is that observed in the Blairsville basin, and at a short distance south from the State line in West Virginia, the benches are as indefinite as in the Blairsville basin or in the Ligonier valley.

The quality of the coal appears from the following analyses:

I. Captain Kendall, German township, Fayette county. (D. McCreath.)

II. McCormack heirs, Franklin township. (D. McC.)

III. A. Townsend, Perry township. (D. McC.)

IV. Fulton and Pinkerton, Sewickley township, Westmoreland county. (A. S. McCreath.)

V. Westmoreland Coal Company, North Huntingdon township. (Average of three.) (A. S. McC.)

VI. Penn Gas Coal Company, (average of three,) Penn township. (A. S. McCreath.)

VII. Saltsburg Coal Company, Loyalhanna township. (D. McC.)

VIII. M. Kunkle, Bell township. (A. S. McCreath.)

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Water,	1.040	0.980	0.890	1.200	1.427	1.517	1.070	0.970
Volatile comb. matter,	32.815	33.635	34.545	32.055	37.980	39.873	35.515	37.845
Fixed carbon,	60.241	60.200	59.450	54.830	54.588	57.200	56.458	53.234
Sulphur,	1.249	0.905	0.885	0.635	0.638	.710	2.257	1.541
Ash,	4.655	4.300	4.220	10.390	5.357	3.612	4.700	6.410
Per ct. of coke,	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Color of ash,	gray.	cream.	r'd-gray	gray-r'd	r'd-gray	cream.	r'd-gray	r'd-gray

In the northern portion of this basin, the coal is of excellent quality, and that obtained on and near the Pennsylvania railroad is the typical gas coal of the country. The upper bench everywhere shows a tendency to become free-burning,

and at Brownsville, on the Monongahela, in one extensive mine, the whole bed is almost a block coal. From the extreme northern out-crop to Brownsville, the bed yields a good shipping coal, which is highly esteemed for its steam-producing power. South from Brownsville, the coal becomes softer, and is no longer a shipping coal, but is useful for coking.

At most localities within the Lisbon trough, the roof is good, and troubles are few in number. Horsebacks occasionally occur, which render the roof unsound for a few yards, but, with the exception of some seen near Penn station, in Westmoreland, they are usually small. Near Irwin, in the same county, there are some sandstone horsebacks of grievous dimensions, which not only cut out an enormous amount of the coal, but also injure the quality of the bed for many feet on each side. Clay veins are of frequent occurrence throughout the trough, and some of these are wide and have great length. Almost without exception, they cause deterioration of the coal adjoining.

Waynesburg and Nineveh Troughs.—Within these troughs, the bed shows no difference from the same bed in the southern prolongations of the basins in the Greene and Washington district. For the manufacture of gas and for shipping, the coal is not inferior to that obtained in the Lisbon basin. Along the Monongahela river, the largest coal-works are here. An analysis of a specimen obtained at Mr. J. Hunter's pit, in Burrell township, of Westmoreland, gave the following result: (A. S. McCreath.)

Water,	1.250
Vol. comb. matter,	42.110
Fixed carbon,	48.820
Sulphur,	2.075
Ash,	5.745
	<hr/>
	100.
Per cent. of coke,	57.640
Color of ash,	Gray.

A comparison of these analyses shows a fact long ago perceived and discussed by Prof. H. D. Rogers. The per centage of volatile matter in the *Pittsburg coal* diminishes

eastward, until at the last exposure, west from the Allegheny mountains, the coal becomes only semi-bituminous. Whether or not a similar change takes place in the higher coals of the series is not known, for the economical value of those is so slight in the eastern troughs, as not to justify the expense of making the numerous analyses necessary to determining the matter. For the change in the *Pittsburg*, Prof. Rogers accounted by supposing that increased disturbance of the strata had led to the loss of volatile matter. This explanation is hardly capable of accounting for the loss of nearly 23 per cent., and certainly cannot account for the difference of 15 per cent., existing between the coals on the west side of Chestnut ridge and those on the west side of the Alleghenies. A comparison of the several ridges, known as the main Alleghenies, Negro mountain, Laurel ridge, and Chestnut ridge, does not afford any basis for Prof. H. D. Rogers' hypothesis, since the dips on the west side of Chestnut hill are little less than those on the west side of the Alleghenies, and certainly are quite as steep as those on Negro mountain, over which the Lower Productive Coals pass. If the changed condition of the coal be due to metamorphism, arising from the transformation of motion into heat, we should find the coal as much altered on the Chestnut ridge as in the synclinal between Negro mountain and the Alleghenies, where the dip is almost nothing. Instead of this, there is a difference of 15 per cent. in the volatile matter. The cause for the difference in composition must be sought elsewhere.

That the increased disturbance of the strata cannot have been the agent producing the changed composition of the coal, is shown also by analyses of the *Upper Freeport coal bed*, in the first basin west from the Alleghenies. That bed, having a wider distribution than the *Pittsburg*, could not fail to be equally exposed to the disturbing influences. But the analyses prove that there is no such decrease in this direction, for the proportion of volatile matter is an extremely variable quantity in the first basin, in some cases being as high as 25 per cent., and that, too, on the slope of the Alleghenies.

If the tables showing the structure of the *Pittsburg coal* in the different troughs be compared, it will be seen that there is a marked and gradual change in structure eastward. The great alteration occurs between the Lisbon and the Blairsville basins. The steps of this change are perceptible in the southern portion of the district, where the Saltsburg anticlinal flattens and permits the coal to pass over it. On this axis the change is found to be gradual, not abrupt. In West Virginia, in the widened Lisbon trough, the Blairsville condition prevails. As has been intimated in a previous chapter the Lisbon synclinal eventually takes the place not only of the Blairsville but also of the Ligonier basin, and the *Pittsburg coal bed* is seen near the crest of the horizontal strata, which probably represent the resultant axis of Chestnut and Laurel ridges. The Ligonier structure is the one seen on the Staunton pike, in West Virginia, from the crest of the west branch of Chestnut ridge to the last appearance of the bed on the crest of the Chestnut-Laurel ridge axis. It is amply evident, then, that the change in structure observed in the separated basins northward, is the result of a gradual change in the conditions under which the bed was formed. This changing condition must have prevailed throughout, for near the Conemaugh the Blairsville structure is sometimes recognized in the Greensburg basin, just as the Greensburg structure is occasionally seen in the Blairsville basin. The conditions under which the bed was formed seem, therefore, to have changed toward the east throughout the whole area, but, at the same time, the change is more marked toward the south-east, the direction of the line along which Prof. Rogers' specimens for analysis seem to have been obtained. This too is the direction of increased disturbance in the rocks, and in this direction the coal shows a decreasing proportion of volatile matter.

Since the increase of disturbance in the rocks is not sufficient to account for the decrease in the volatile matter, and since the bed shows a gradual change in structure, corresponding to the change in composition, I am led to the conclusion that the loss in volatile matter is due to the altered conditions under which the bed was formed.

CHAPTER VI.

The Lower Barren Series.

The rocks of this series are reached along the face of Chestnut hill and are exposed on the arches of the several anticlinals within the district. On the Blairsville axis they occupy a broad strip of comparatively inferior land extending from the Conemaugh river to the merging of that axis with the Saltsburg. On the latter a similar strip of land, known as the "Barrens," extends from the Conemaugh river to Springhill township, of Fayette county, near the southern limit of the district, but owing to the decreasing height of the arch, the strip becomes narrower southward, until in Springhill township, the *Pittsburg coal bed* crosses the axis and conceals the rocks of this series.

The Lower Barrens are the only rocks exposed along the crest of the Waynesburg axis north from the Pittsburg and Greensburg pike in Westmoreland county; but at a short distance south from that road the *Pittsburg coal bed* crosses the arch and the Barrens are seen only in ravines. In north-western Westmoreland and in Allegheny county north from the Youghiogheny river no rocks are reached aside from the Barrens, excepting small areas of the *Pittsburg coal bed* on the highest hills and a narrow strip of the Lower Coals along the Allegheny and the Conemaugh.

The rocks of this series, therefore, are the surface rocks in by far the greater part of the district. At the same time they yield so readily to the weather as to produce a handsomely rounded surface, which, though sufficiently attractive as scenery, and highly advantageous to the farmer, affords few exposures for the geologist. In nearly all cases, sections obtained away from the railroads proved imperfect and unsatisfactory.

An approximate section of the series is as follows:

Section of Barren Series.

Fig. 6.

1. <i>Pittsburg coal bed</i> ,		—
2. Fireclay,		8'
3. Shale,	10	10'
4. Limestone,	6	6'
5. <i>Coal bed</i> ,	25	1'
6. Shale,	25	25'
7. Limestone,	10	8'
8. Shale,		10'
9. <i>Coal bed</i> ,		11'
10. Limestone,		5'
11. Connellsville sandstone,	60	60'
12. Shale,	35	35'
13. <i>Coal bed</i> ,		1'
14. Limestone,		4'
15. Morgantown sandstone,	50	50'
16. Clay,	9	9'
17. <i>Barton coal bed</i> ,	1	1'
18. Shale,	30	30'
19. Crinoidal limestone,		4'
20. Shales and clays,	100	100'
21. <i>Coal bed</i> ,		2'
22. Shale,	60	60'
23. Black limestone and shale,		4'
24. Shale and Shaly sandstone,	35	35'
25. <i>Coal bed</i> ,		2'
26. Shale,	30	30'
27. Mahoning s'dstone,		—
Total,		491½

Lower Barren Series.

In this series the only strata which may be regarded as persistent are the *coal bed*, No. 5, the Limestone, No. 4, the Connellsville sandstone, the Morgantown sandstone, the *Barton coal bed*, the Crinoidal limestone and the black lime-

5—KK.

stone. All the other sandstones, limestones, and coal beds seem to be purely local, and are subject to the most abrupt changes. Even of the list given, only the Morgantown sandstone, the *Barton coal* and the Crinoidal limestone fully deserve to be called persistent. These form a well-defined group which with rare exceptions can always be identified. The others show such changes in structure and appearance, that very frequently they can be recognized only with difficulty, and in most instances they are of little assistance in determining horizons.

In most localities there is a bed of limestone at a short distance below the *Pittsburg coal*. The interval between the two is from less than one foot at Irwin to 23 feet at Dunbar. A similar degree of variation was noticed in the report on the Greene and Washington district. The limestone is often double, as represented in the general section, and the little *coal bed*, No. 5, occurs between the divisions. The parts of this limestone are separated at times by an interval varying from two to twenty feet. They vary in composition, sometimes one, sometimes both, being sufficiently pure to make good lime, while at other times both divisions are worthless. The little *coal bed* was seen in Georges, Nicholson, Perry, Springhill, Dunbar, and Connellsville townships, of Fayette, as well as in North Huntingdon, Penn, Hempfield, and other townships, of Westmoreland. It is always thin. The *coal bed*, No. 9, is shown in Georges, Springhill, and Nicholson, of Fayette. It is not mined.

The Connellsville Sandstone is an important member of the series, and is persistent as sandstone or as sandy shale at almost all exposures. The interval to the *Pittsburg coal bed* varies somewhat, being only 50 feet on Dunbar creek, but becoming as much as 80 feet elsewhere. This variation may be due in part to changes in the rock itself, for at many places it is a sandstone 70 to 80 feet thick, while at others, the upper portion for fully 30 feet is sandy shale. It is well exposed on Georges creek, along Redstone on both sides of the Saltsburg axis, on Dunbar, and on the Youghiogheny, on both sides of the same axis. At all of these

localities it is, for the most part, a sandstone, though between Dunbar station and Connellsville the change in the upper portion is well shown. Northward from this, the rock varies greatly; sometimes it is a sandstone, but often only a sandy shale. It is present in both forms on the Pennsylvania railroad.

THE BARTON GROUP.

I have given this name to the portion of the section, including Nos. 15 to 19. It is so constant and shows such slight variation in general character that it deserves to be especially distinguished.

The Morgantown Sandstone is thoroughly persistent and is usually a massive rock. It was seen in Springhill and Georges townships; is exposed on the hill-tops on Redstone, under the arch of the Saltsburg axis; is a very bold sandstone on Dunbar creek; on the Youghiogheny river, it is equally bold both above and below the plane of that axis; it was seen on the South-West Pennsylvania railroad in East Huntingdon township; on the Pennsylvania railroad in North Huntingdon; on Beaver run, in Salem township; as well as at numerous other localities in northern Westmoreland. At nearly all exposures the rock is compact, of a gray color, slightly tinged with red, and is undoubtedly an excellent building stone. It is by far the most compact sandstone of the Lower Barren Series, and bears much resemblance to the great sandstones of the higher series. It may readily be mistaken for the Mahoning sandstone.

The *Barton coal bed* is not of economical thickness at any exposure within the district, but is so persistent, both here and in other portions of the State as well as in West Virginia, that it fairly deserves recognition as one of the regular beds of the whole column. It is more persistent than any bed of the Lower Productive Coal Series, except the *Upper Freeport*, and in this respect it is inferior only to the *Pittsburg*, *Waynesburg*, *Waynesburg "a,"* and *Washington*, of the higher beds. It was seen in Georges, Springhill, North Union, Dunbar, Connellsville, Perry, and Tyrone townships, of Fayette; in East Huntingdon, Hemp-

field, Derry, Salem, Washington, Penn, North Huntingdon, and South Huntingdon townships, of Westmoreland. In other townships where its place is reached, the bed is concealed. It is from 6 to 18 inches thick, and, when more than one foot, is double. The coal is usually quite good.

The Crinoidal Limestone is the same with the Green Fossiliferous Limestone of the old Pennsylvania report. In the final report it is erroneously identified with the Black Limestone in the description of the strata about Pittsburg. Following the statement there made, I was led into the same error in the report on the Greene and Washington district. As the name is fully characteristic of the rock, describing its distinctive physical feature, it answers quite as well for identification of the stratum as does the name which I used to describe the prevailing type of its fossils. For this reason the older name should be retained in preference to "Crinoidal." This rock has a greenish-gray color, usually weathers into sharp blocks, and contains great numbers of fossils, among which the detached plates of certain crinoids predominate. This stratum was seen in North Union, Springhill, Dunbar, and Perry, of Fayette, as well as in East Huntingdon, Hempfield, Penn, North Huntingdon, Salem, Washington, and Franklin townships, of Westmoreland. Everywhere the characters are the same.

ROCKS BELOW THE GREEN FOSSILIFEROUS LIMESTONE.

Below the Green Limestone the variations are excessive. In the generalized section, 100 feet of shales and clays underlie that limestone. This seems to be the condition in the southern part of the district, where for the most part such sandstones as do occur in this portion of the section, are shaly and more or less argillaceous. At times, however, as on the Monongahela river above New Geneva, massive sandstones occur, but along the face of Chestnut hill they are wanting. A massive sandstone, observed on Redstone creek on the eastern slope of the Saltsburg axis, evidently belongs here. On the Youghiogheny river, under the Saltsburg axis, there are some great sandstones in the lower portion of the section, which include some coal beds

of local importance. On Jacobs' creek the rocks are sandstones and shales, the latter for the most part sandy. On the Pennsylvania railroad, under the Waynesburg axis, the interval is occupied by fissile shales almost to the Black Limestone, and a similar condition seems to prevail under the Saltsburg arch. On the Conemaugh there occurs under that arch a series of massive sandstones.

The coals below the Green Limestone are quite as variable as the other rocks. The little coal, seen under the limestone in the Greene and Washington district, was not found within this district at any locality except in the immediate vicinity of Pittsburg. A thin coal bed occurs within the first 100 feet below the limestone on Dunbar, and a bed holding a similar position was seen in Springhill township, nearly three feet thick. The same bed was found on the Youghiogheny river below Layton station, and at that station it is high up in the hill. The coal bed, No. 21 of the section, seems to be fairly persistent. It is represented on the Pennsylvania railroad by coaly shale under the Waynesburg and Blairsville anticlinals, while on the face of Chestnut hill it is always a coal, but too thin to be workable. This is, no doubt, the middle coal bed seen at Layton station, on the Youghiogheny river, where it is one foot thick. At that locality, a still lower bed was seen, which may represent the No. 25 of the general section.

In the northern part of the district, near the Conemaugh river, and especially near the Waynesburg and Saltsburg axes, there is a thin coal bed almost directly on top of the Mahoning sandstone. This was found on the Conemaugh, on the Loyallhanna, in the vicinity of Beaver run, as well as on Pucketta creek. A thin coal bed was found in nearly the same position on the Sewickley, under the Saltsburg axis. This I am inclined to regard as the same with the lowest coal of the section. One is justified in saying that at from 5 to 30 feet above the Mahoning sandstone there is a coal bed everywhere throughout the district. The same bed is seen in West Virginia, at the southern termination of the Blairsville trough.

In Nos. 2 and 26 of this series iron ore occurs at various

localities. These are the constant ore-horizons, though the quantity is not always sufficient to be of economical value. Ore is sometimes found near the Green Limestone and in the southern part of the district the whole section below that limestone is apt to show ore-bearing layers, some of which are of local importance. No detailed reference to them is necessary here as the ore-beds of the district will be described in a separate chapter.

THICKNESS OF THE SERIES.

The thickness of the lower barren series seems to vary irregularly, at least no law of variation was discovered during the past season. Unfortunately the changes in character of the rocks prevents one from holding his horizon, so that although fragmentary sections from 50 to 100 feet long are common enough, there is no way of tying them together. For the most part the thickness of the series can be determined only approximately, and that usually in no way except by measuring the height of hills, where the *Pittsburg* or the *Upper Freeport coal bed* is within striking distance. On Dunbar creek a definite measurement of the whole series was obtained, showing the thickness to be very nearly 520 feet; on Cove run, in North Union township, of Fayette, the same interval is but little more than 480 feet; in the extreme southern portion of the district, on the Monongahela river, it is little more than 400 feet; on the Youghiogheny river, under the Saltsburg axis, near Layton station, the thickness is certainly much greater, for at one locality 520 feet were measured directly without reaching the *Pittsburg coal bed*, though the base from which the measurement began is fully 100 feet above the *Upper Freeport coal bed*. The interval here is certainly not less than 560 feet from the Mahoning sandstone to the *Pittsburg coal bed*. Beyond this northward the series seems to be quite constant, for on the Pennsylvania railroad, under the Waynesburg axis, the Black Limestone is at 416 feet below the *Pittsburg coal*, which is about 30 feet less than at Dunbar. No satisfactory determination of the interval between the Green Limestone and the *Freeport coal bed* was made

on Beaver run or the Loyalhanna, but on the Conemaugh, above Saltsburg, 230 feet were measured above the Mahoning sandstone without reaching the Limestone, which, judging from a section obtained in Indiana county, is probably 50 feet higher. In this region the distance from the *Pittsburg coal* to the Green Limestone varies from 275 to 300 feet, so that the lower barrens must have a thickness of not far from 550 feet. I have been unable to find any locality where the thickness of the series exceeds 550 feet except the one on the Youghiogheny river. There the exposures are incomplete near the top of the hill and the measurement is of little value further than that it shows the thickness to be at least 560 feet, for the *Pittsburg bed* may have just escaped the hill-top.

VARIATIONS IN THE SECTION.

In this chapter, frequent reference has been made to the excessive variation in the character of the rocks and the consequent impossibility of tying together fragmentary sections, which in the other series would be sufficient for satisfactory working out of the structure. To some who read this report these statements may seem to be exaggerated, but a comparison of a very few sections will suffice to show that the conditions are as stated. In Westmoreland county, compare the first 100 feet below the *Pittsburg coal* as shown in Hempfield township, under the Blairsville and Saltsburg anticlinals, and in North Huntingdon, under the Waynesburg axis. Of these the first and second are but three miles apart, being on the opposite sides of the Greensburg trough. The variations in Fayette county are shown by sections obtained on the several streams. Of these, one may compare that at New Geneva, on the Monongahela, (Nicholson township,) on Georges creek, near Smithfield, (Georges township,) and on Dunbar creek, (Dunbar township,) in all cases using only the first hundred feet below the *Pittsburg coal*. This portion of the section is taken because it shows less variation than any other, except that occupied by the stable *Barton group*. Let these last

be compared with the following, which is seen in West Virginia, about eight miles above New Geneva :

1. <i>Pittsburg coal bed</i> ,	—
2. <i>Shale</i> ,	14'
3. <i>Limestone</i> ,	3'
4. <i>Coal bed</i> ,	2'
5. <i>Shale</i> ,	3'
6. <i>Sandstone</i> ,	25'
7. <i>Shale</i> ,	8'
8. <i>Limestone</i> ,	3'
9. <i>Shale</i> ,	4'
10. <i>Limestone</i> ,	1'
11. <i>Shale and sandstone</i> ,	22'
12. <i>Limestone</i> ,	1'
13. <i>Shale</i> ,	18'
Total,	104'

The limestones of the Lower Barrens are equally variable with the other strata. In the whole of the West Virginia section, there are eight layers, with a total thickness of 28 feet ; at New Geneva, there are six, with a total of 43 feet ; at Dunbar, there are but three, with 28 feet. Under the Blairsville axis, on the Pennsylvania railroad, there are five, showing in all 30 feet, while under the Waynesburg there are eight, with a total of 22 feet. Some of the sections from which these totals are taken fail to show the full thickness of the series, but they reach to a horizon below which no limestone has been found, except the exceedingly ferruginous rock known as the Johnstown ore-bed at the base of the whole series.

It is altogether improbable that these variations occur irregularly, although such would appear to be the fact from the imperfect records in our possession, and I have no doubt that, were there opportunities for procuring detailed sections as complete as those obtained in the Upper Coals and Upper Barrens, there would be discovered as distinct and satisfactory cause for these variations, as that which has been found in the upper two series. At present, however, all efforts to work out the law of variation seem to me to be hopeless.

CHAPTER VII.

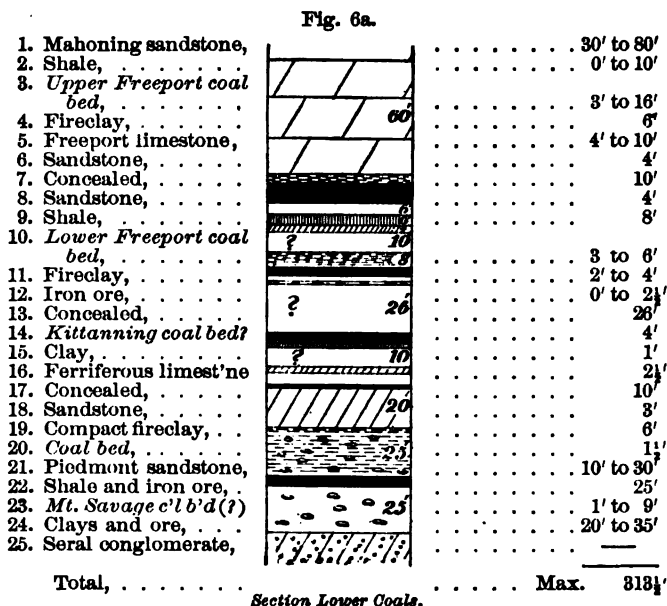
The Lower Productive Coal Series.

The rocks of this series are fully brought to the surface along the face of Chestnut Hill. The upper portion of the section was seen on the Loyalhanna, under the Blairsville axis ; on Redstone, the Youghiogheny, Jacobs creek, both Sewickleys, the Loyalhanna, and the Conemaugh, under the Saltsburg axis ; on Beaver run and the Conemaugh, under the Waynesburg ; and is kept up on the Conemaugh and the Allegheny, to near the line of Allegheny county, by the influence of the Pin-Hook axis. Along the face of Chestnut hill, where, alone within the portion of the district already examined, the whole series comes to the surface, the covering of debris is so thick that detailed sections cannot be obtained ; and even the best measurements procured during the past season show serious gaps, which I have been unable to fill up. This difficulty arises in great part from the fact that the sandstones of the group yield readily to the weather, and break off in great masses, which, in their turn, are broken up, and form a coating too thick to be removed by the little streams, which come down the mountain side. In a large portion of the area, the lower coals are not caught directly on the slope of the mountain, but lie at the base, where the north and south streams have excavated valleys, in which everything is concealed.

Ample opportunities for determining the thickness of the series are afforded at many places along the mountain, and a great number of observations leads me to the belief, that in the southern part of the district it is rarely more than 150 feet, exclusive of the Mahoning sandstone. At many localities, it is certainly not more than 125 feet, and the record of an oil-boring, in South Union township, of Fayette county, shows the interval between the *Upper Freeport* and the *Mount Savage* (?) coal bed to be barely 100 feet ; but northward from the Redstone creek, the thickness increases, and becomes 270 feet, on the Youghiogheny.

The variations in the rocks of this series are excelled only by those already referred to as occurring in the Lower Barren Series, and it has been found utterly impossible to make satisfactory identifications of the coals here with those found in the more northern districts. The following is perhaps the best average section, and is given here as it exhibits the full number of coal beds found:

Section of Lower Productive Coals.



THE MAHONING SANDSTONE.

This great sandstone is persistent, though at some localities it is represented by shale. The exposure above the *Upper Freeport coal bed* is not always complete, so that occasionally one must regard the sandstone as occupying the whole interval between the coal and the Johnstown ore bed.

When present as a sandstone, the mass is very often double, and holds midway, or nearly so, a *coal bed* of little importance. The rock is commonly more or less coarse in grain, contains some feldspar and varies from massive to

flaggy or even shaly. In Springhill township, of Fayette, the interval between the *Upper Freeport coal* and the Johnstown ore-bed is 60 feet, and is filled with sandstone and shale, the latter being at the base and 15 feet thick. The exposure of the sandstone is imperfect, and the presence of the little *coal bed* could not be determined. In South Union township, of the same county, near the mouth of the deep hollow, which Redstone creek makes in the side of Chestnut Hill, the sandstone is well exposed, 60 feet thick, and contains the little *coal bed* at 25 feet from the top. The rock is flaggy, but becomes compact at several places along the run. In North Union township, the sandstone was seen on Cove run, as well as at some localities near the National road. The thickness is less here than in the adjoining township, and is barely 35 feet. The rock is coarse, flaggy, and contains many huge impressions of *Lepidodendron*, which are well preserved. At all exposures in this township it is single, and the little *coal bed* is absent. In Dunbar, on the creek of the same name, the two divisions are present, and are respectively 35 and 40 feet thick, being separated by the *coal*, which is double, and nearly three feet. The rock is more or less flaggy, and is rather coarse ingrain.

Northward from this locality the thickness of the sandstone, seems to diminish, and in Mt. Pleasant township, of Westmoreland, near the head waters of Jacobs' creek, the interval between the *Upper Freeport coal* and the Johnstown ore is only 35 feet, and is filled with shale. In Derry and Unity townships, of the same county, no thoroughly accurate measurement was obtained, but the thickness is not far from 40 feet. The rock is more or less flaggy, and contains occasional impressions of plants.

Under the arch of the Blairsville anticlinal, this sandstone was recognized only on the Loyalhanna, near Braely's old mill, where it is flaggy, but the exposure is not sufficient to show whether or not the little coal bed is present.

Under the Saltsburg axis, the Mahoning Sandstone was seen on every important stream north from Redstone. On that creek it is a shale; on the Youghiogheny it is a sand-

stone, and not far from 50 feet thick; so also on Jacobs' creek, but here the little coal bed seems to be absent; on the Sewickley it is a compact to flaggy sandstone fully 40 feet thick; but on the Little Sewickley, where the exposure is imperfect, it seems to be almost wholly shale. On the Loyalhanna and Conemaugh, it is represented by a sandy shale not more than 35 feet thick, that being the interval between the *Upper Freeport coal bed* and the Johnstown ore.

Under the Waynesburg axis, this was seen as sandstone on Beaver run and the Conemaugh, and nearly 50 feet thick. Along the Conemaugh and Allegheny rivers, where it is kept up by the influence of the Waynesburg and Pin-Hook axis, it is massive and only moderately coarse in grain. This line shows the stone in its typical character.

THE UPPER FREEPORT COAL BED.

Within this district the *Upper Freeport coal bed* is present at all localities where its horizon is exposed, but it shows such variations in thickness, that it can hardly be regarded as of much economical importance. The greatest size is attained along the face of Chestnut hill, where the bed is mined in nearly every township from the Conemaugh to the Virginia line. Here its variations are handsomely shown. In Springhill, of Fayette, it consists of two well-marked divisions. This is a common character. The section at one exposure in Springhill shows:

Fig. 7.

1. Coal, 0' 11"	} 17' 1"
2. Shale, . . . . .		. . . . . 3' 0"
3. Slaty coal, . . . .		. . . . . 0' 2"
4. Clay,	16	. . . . . 1' 6"
5. Coaly shale, . . .		. . . . . 0' 4"
6. Clay,	7	. . . . . 1' 0"
7. Cannel shale, . . .	18	. . . . . 0' 5"
8. Drab clay,	10	. . . . . 0' 3"
9. Coal, with clay layers, . . . . .		. . . . . 1' 8"
10. D'k c'y, coal streaks,	16	. . . . . 0' 10"
11. Coal, prismatic, . .		. . . . . 2' 0"
12. Hard clay, . . . .		. . . . . 1' 6"
13. Coal, . . . . .		. . . . . 3' 6"

Upper Freeport Coal Bed, Springhill.

Making a total of 17 feet 1 inch. The upper division includes all above No. 12. In Georges township the structure is somewhat different, the upper division being represented by 3 feet of black shale, containing streaks of coal, while the lower division is 9 feet 4 inches thick. It is possible, however, that the bottom bench of this lower division, which is 3 feet thick, and separated from the rest of the bed by 8 inches of clay, may be the same with the lower division in the Springhill section. In South Union the 3-foot bench is seen, separated from the upper division by 16 inches of clay, the upper division being in four benches, divided by clays, the whole being 6 feet thick. The lower division rests on one foot of mixed coal and slate. The bed retains this form, and approximately the same thickness, until a short distance north from the National pike, beyond which it rapidly thins, so that on Cove run it is only from 2 feet to 3 feet 6 inches, but in Dunbar, the ordinary character of the bed is seen in the openings on Dunbar creek, where the section is:

Coal, 2 feet; *clay*, 3 feet; *coal*, 5 feet 8 inches; total, 10 feet 8 inches.

The same general structure was seen on the Youghiogheny, above Connellsville, where the divisions are 2 inches and 6 feet, separated by one foot of clay. In Mt. Pleasant, of Westmoreland, the coal was seen on Jacobs' creek, where it shows the two divisions, the upper being a mass of coal and black shale, in alternating layers, with a total thickness of 37 inches, and the lower containing 36 inches of coal. The bed is known as the 3-foot bed, as only the lower division is mined. In Derry, along the Loyalhanna, only the lower division seems to be present, but further north the bed is again double, and on the road leading across the mountain from New Derry to Ligonier it shows:

Coal, 3 feet; *clay*, 1 foot 6 inches; *coal*, 3 feet 1 inch; total, 7 feet 7 inches.

Under the Blairsville axis, this coal bed is brought up on the Loyalhanna, near Braely's old mill, where it has about 3 feet of coal. The Conemaugh does not cut deeply enough to show this bed under the arch of the Blairsville axis.

Under the Saltsburg axis the *Upper Freeport coal bed* is exposed on every important stream north from and including Redstone. On that creek it was seen for a distance of fully two miles, beginning at the village of West Middletown, in Manellen township. Along this line there are two coal beds, which are 42 feet apart, and clearly belong to the lower productive coal series, but no way exists whereby their relations to the section may be accurately determined. The Green limestone is shown in fragments at a distance above the higher coal, which seems to show that it must be the *Upper Freeport*. If this be so, the Freeport Limestone, which is persistent at all other exposures within the district, is wanting. Both beds are thin, and the lower one is barely thick enough to repay working along the out-crop.

On the Youghiogheny river the bed is shown above Layton at the forty-eighth mile post. It is very thin and good for nothing, though some enterprising individual has attempted to make an exploratory opening, hoping, no doubt, that the coal would grow thicker under the hill. The section here is :

Coal, 18 to 27 inches ; *clay*, 1 to 2 inches ; *coal*, 2 inches.

On Jacobs' creek the bed is exposed under this axis, and is occasionally mined. Its thickness varies from 3 to 4 feet.

On Big Sewickley, the *Upper Freeport coal bed* is exposed for a distance of several miles, as the stream meanders through the arch of the axis. The distinct division into two parts is wanting and the bed is broken by thin partings, as at the Loyalhanna gap, in Chestnut hill, so that if the divisions are here, one cannot recognize them. The thickness varies from 2 to 5 feet. This bears such close resemblance to the *Lower Freeport* that, where the Freeport Limestone is not exposed, one cannot readily determine which bed is the one under examination. On the Little Sewickley the bed is again double, and shows a great expansion, as follows :

Coal, 3 feet ; *clay*, 2 feet 6 inches ; *coal*, 5 feet ; total, 10 feet 6 inches.

On the Loyalhanna and the Conemaugh the bed is single, and its thickness varies from 3 feet 8 inches to 5 feet.

Under the Waynesburg and Pin-Hook axes, the *Upper*

Freeport coal bed is exposed only in the immediate vicinity of the Conemaugh and Allegheny rivers. The bed is broken into benches by partings, but none of these is sufficiently thick to make complete division of the bed into two parts, as on the slope of Chestnut hill. Its thickness varies from 4 to 8 feet.

The *Upper Freeport* is far from possessing economical value in accordance with its thickness and area. At many openings along the face of Chestnut hill the coal is excellent, but for the most part in other localities it is quite inferior. The following analysis shows the general character of the bed :

I. J. Snodgrass, Loyalhanna township, Westmoreland county. (A. S. McCreath.)

Water,	0.890
Volatile comb. matter,	84.100
Fixed carbon,	56.088
Sulphur,	3.932
Ash,	4.990
	<hr/>
	100.000
Percentage of coke,	65.010
Color of ash	Cream.

For the most part this bed is regular, both in the roof and underclay. Horsebacks seldom give any trouble, and clayveins were found only on the Loyalhanna, under the Saltsburg axis.

Along Chestnut hill there is, between the *coal* and the Freeport Limestone, a fireclay which is usually of good quality. In the southern part of the district this clay is plastic and very good, but further north it contains more or less of non-plastic, and is mixed with sandy inferior material, which spoils the whole. Under the Saltsburg axis the interval is sometimes filled with plastic fireclay and sometimes by a carbonaceous shale, which contains many impressions of leaves. Under the Waynesburg and more western axes, the material filling the interval is plastic clay.

THE FREEPORT LIMESTONE.

The Freeport Limestone is found at from 6 to 10 feet

below the upper Freeport coal bed at almost all exposures along the face of Chestnut hill. It is a blue, somewhat earthy rock, which at many localities is pure enough to yield a fairly good agricultural lime. Portions are often ferruginous at the outcrop, but when followed under cover they become solid limestone. The thickness varies from 4 to 10 feet.

Under the Saltsburg axis it is either not exposed or not reached on Redstone creek. It was not found in place on the Youghiogheny, but northward it is well exposed on Sewickley creek, 18 inches thick and very ferruginous. There the interval between it and the coal is 12 feet. On the Loyalhanna it is 5 feet thick and yields an excellent lime. The interval to the coal is barely 5 feet. On the Conemaugh, the limestone is from 3 to 5 feet thick, and only 3 feet below the coal. Its color is nearly cream, and the rock is evidently argillaceous, but yields a good lime.

Under the more western axes this limestone is from 6 to 10 feet thick, and, though somewhat argillaceous, usually produces a lime good enough to be employed for all ordinary purposes.

Below the limestone the character of the rocks varies greatly. On the Conemaugh, fine non-plastic clays occur directly under it, and at one time they were dug extensively at some localities above Saltsburg. At some other places sandstone occurs instead of the clay, but for the most part this interval is so imperfectly exposed that the nature of the rocks filling it cannot be made out with any degree of certainty.

THE LOWER FREEPORT COAL BED.

This is one of the most uncertain beds in the series. It was seen in Springhill, Dunbar and Connellsville townships, of Fayette, and in Hempfield and Loyalhanna townships, of Westmoreland. It occurs, also, on the Conemaugh and Allegheny rivers, in the north-western part of the latter county. In Springhill, it is 3 feet 10 inches thick, divided into three benches by thin layers of clay, and the coal is far from being good, as it contains streaks of clay and much

pyrites. In Dunbar, it is exposed at the furnace, where its blossom indicates a thickness of about 2 feet 6 inches. But there being no opening, definite information respecting thickness and quality could not be obtained. In Westmoreland county, along the face of Chestnut hill, this bed was not seen.

Under the Saltsburg axis, this bed is certainly absent on the Youghiogheny river, for there its place is well exposed. On Sewickley creek, under that axis, the *Lower Freeport coal* becomes important, and is mined, but it varies so much in thickness and quality that it can hardly be thought valuable. The coal is very poor, and contains so much sulphur as to clinker badly. On the Loyalhanna it is 3 feet thick, and is said to yield good coal. On the Conemaugh, above Saltsburg, the Freeport Limestone is 100 feet above the river, but the whole interval is concealed, and the *Lower Freeport* has never been seen.

Under the Waynesburg and Pin-Hook axes the *Lower Freeport* occurs along the Conemaugh. The details respecting the bed here will be found in Mr. Platt's report on Armstrong county. Along that line the bed is thin and seems to be broken up by numerous clay partings, so as to render its coal inferior.

BETWEEN THE LOWER FREEPORT COAL BED AND THE PIEDMONT (?) SANDSTONE.

A thin fireclay underlies the *Lower Freeport coal bed*. Below it on the Youghiogheny, the Sewickley and the Loyalhanna, there is a sandstone, which, no doubt, is the same with that known further west and north as the Freeport Sandstone. Below this no general section can be made. In Springhill township, of Fayette, one finds in this interval, at about 30 feet below the *Lower Freeport coal bed* a thin *coal*, said to be 4 feet thick, which is perhaps the representative of the *Kittanning*. At one foot below it, is a ferruginous limestone, somewhat more than 2 feet thick, and at 13 feet lower is a compact fireclay, 6 feet thick, and of excellent quality. Under this is a thin *coal bed* resting almost directly on the Piedmont (?) sandstone, thus making

the interval between the *Lower Freeport coal bed* and the Piedmont Sandstone about 60 feet.

Further north on the National road the *Lower Freeport coal bed* is wanting, but about midway between the *Upper Freeport* and the *Mt. Savage (?) coal bed* there is a *coal*, which, judging from the blossom, may be 18 inches thick, and possibly represents that which, in Springhill, I have hesitatingly identified with the *Kittanning*. In North Union, near the Lemont furnace property, there is no coal bed exposed between the *Upper Freeport* and the Piedmont (?) sandstone, and here, as on the National road the Ferriferous Limestone is wanting. On Dunbar creek, the limestone is absent, but here is a double *coal* bed which may be the *Kittanning*(?). Beyond this northward the exposures are very imperfect and few of the rocks belonging to this interval were found in any of the ravines.

THE PIEDMONT SANDSTONE. (?)

Prof. Lesley has identified with this sandstone one which is persistent in the southern portion of the district, and lies at from 40 to 70 feet above the conglomerate. It is the same with that, which in my "Notes on the Geology of West Virginia," I have called the "*Tionesta*," as it holds the place in the series to which that rock was assigned in the old report on the geology of Pennsylvania. Since the name *Tionesta* has been erased from the list, as a synonym for the Seral Conglomerate, Prof. Lesley's identification must be accepted provisionally, until careful tracing can be had to determine the relations.

Within this district, the Piedmont (?) Sandstone is exposed only along the face of Chestnut hill, as no stream cuts deeply enough into the other axes to reach it. In Springhill, of Fayette, the rock is thin, seldom more than 10 feet thick, but it is a massive sandstone in one layer. In Georges and South Union townships, it is somewhat thicker but shows the same characters. North from the National road in this county, the structure changes and the rock becomes a thinly bedded flaggy sandstone, 25 to 30 feet thick. It is sometimes known as the upper division of the Conglom-

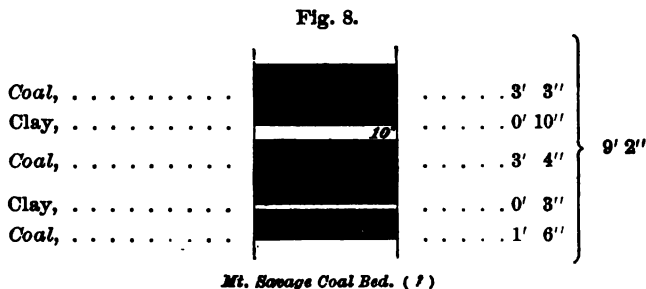
erate, but there is no difficulty in distinguishing the two rocks, anywhere south from the Youghiogheny river, for the Conglomerate is coarser than the other, and always contains some ferruginous matter which stains it. Moreover, in the townships named, the Conglomerate is never flaggy, but always massive, even the long exposed surface becoming only shattered. In this portion of the district, the Piedmont (?) Sandstone is almost wholly free from iron, shows very little feldspar, and has a very even texture. Northward from Jacobs' creek, it becomes less marked, and shows a tendency to become shaly, so that one coming from the north would, perhaps, be surprised to find it so well-marked and persistent as a sandstone, south from that stream. Northward from the Loyalhanna, this rock loses its distinctive features and becomes little more than a sandy shale, differing in no essential respect from any of the other sandy shales belonging to the series.

THE MOUNT SAVAGE COAL BED (?) OR COAL A.

At from 10 to 30 feet above the Seral Conglomerate there is found, along the face of Laurel Hill, a coal bed, which, in some localities, becomes quite thick. This is thought to occupy the place of that, which, in the coal field of western Maryland, has been called the *Mt. Savage bed*. It is most probably the *Coal "A"* of Prof. Lesley's list, and it may prove to be the same as the *Clarion coal bed* of the old reports. This bed varies in thickness to such an extent that it can hardly be traced with satisfaction, and identifications made by geologists are likely to be regarded with some incredulity by persons living within the district.

In Spring Hill township, this bed shows two divisions, 2 feet 6 inches, and 1 foot 3 inches, separated by 3 feet 6 inches of clay, which contains some iron ore of local value. Here and southward to Cheat river, it is known as the *Stratford coal*. The coal itself is of no importance, and at most localities it was exposed only during work for procuring the ore. In Georges and South Union townships, it becomes even 8 feet thick, if the reports given to me be true. Unfortunately, in these townships, all the openings had fallen

shut, so that no measurements could be made. In North Union an opening afforded a good measurement which showed :



But in a neighboring opening, the partings have thickened at the expense of the coal and are each 1 foot thick. On Dunbar creek, this bed is not more than 18 inches thick ; on the Youghiogheny river, above Connellsville, it is very thin, while on Jacobs creek it varies from 3 to 6 feet. Northward from this to the Conemaugh, the bed is very thin, no openings exist, and only the blossom can be seen. On the Conemaugh, it is barely 20 inches thick, and the coal is not good.

On the whole, this bed yields as good coal as that from the *Upper Freeport*, and the variations in thickness are not much greater than those of that bed, so that eventually this coal may become of some value.

Both above and below the *Mount Savage coal bed* (?) there are iron ores, to which reference will be made in a separate chapter. Between the coal and the Seral Conglomerate, there is usually a fire-clay, which, at some localities, has been used in the manufacture of fire-brick, for which purpose it proves well adapted. Indeed, it is a main source of supply to factories of fire-brick along the base of the mountain.

THE LOWER COAL SERIES IN WEST VIRGINIA.

In this State, west from the axis representing the Alleghenies of Pennsylvania, the Lower Coal Series is exposed on the flanks of the several anticlinals. As these successively disappear southward, the rocks soon occupy a comparatively narrow area. But beyond the line of the Staunton and Par-

kersburg pike, this widens, owing to the flattening of the Tygart's Valley anticlinal, and the lower coals are exposed for long distances in the valleys of the more important streams. Little is yet known respecting them south from the Great Kanawha river, and the relations of the beds on that line to those near the Staunton pike are still only partially determined, as the intervening space has not been examined in detail.

The Mahoning Sandstone is a marked feature throughout the whole region, always being distinct, and never showing any tendency to become shale. It is first seen on the Monongahela, near Morgantown, and at the mouth of Booth's creek, four miles further south, it forms a fine cliff fully 70 feet high. In this vicinity, as at so many localities in Pennsylvania, it frequently holds a small coal bed nearly midway. At the gap made through Chestnut hill by the Tygart's Valley river, that axis has so far diminished that this stratum, still a massive sandstone, crosses unbroken. On the Buckhannon river, it forms bold cliffs, and on the Staunton and Parkersburg pike it reaches quite to the base of the Tygart's Valley anticlinal,* actually crossing the flattening, which there seems to represent the Laurel and Chestnut ridges of Pennsylvania. In the northern portion of the State, this rock contains only occasional thin layers of conglomerate, but in Randolph county, as well as in Upshur, these layers become coarser and more numerous, so that near the foot of Rich mountain (the western side of the Tygart's Valley axis) they are very conspicuous. On the Great Kanawha, this rock is well exposed near Charleston, where it holds a coal bed, which is sometimes of workable thickness.

At some localities in the northern part of the State there is a thin bed of coal at a few feet below the Mahoning Sandstone, but it does not seem to be persistent, though on the Great Kanawha, near Charleston, a coal bed is found in precisely this position. Between this bed and the sandstone there is black shale, which is co-extensive with the coal and is richly fossiliferous. This occurs also in the oil-

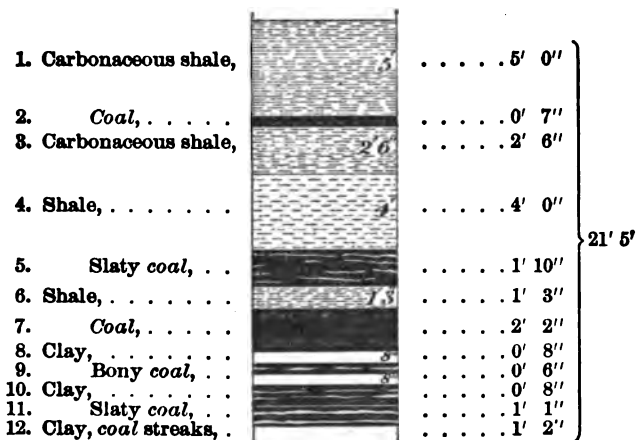
*Which represents the Alleghenies of Pennsylvania.

break of West Virginia, where it is associated with a very thin coal bed, which may be the same with that just referred to. Between this coal and the *Upper Freeport* there is a variable drab shale holding vast numbers of leaf-impressions. In this same interval occurs the black chert of the Kanawha valley, which the geologists of the Virginia survey thought to be so valuable as a guide in a region where little else than coals and sandstones occur in this series. The same chert is found in the oil-break.

The *Upper Freeport coal bed* is persistent along the whole line, and exhibits variations far exceeding any seen in Pennsylvania. Near Cheat river it is barely two feet, and lies immediately under the Mahoning Sandstone. At the river it is 4 feet thick; on the various streams flowing from the mountain to the Monongahela, in Monongalia county, the bed is double, and, in some cases, even triple; further southward it breaks up into many divisions, so widely separated that they can hardly be called benches. On Booth's creek, in Monongalia county, the total thickness is 8 feet 7 inches, and the bed has two main divisions, the upper, 3 feet, made up of alternating layers of coal and shale, and the lower, 5 feet, consisting of coal broken into benches by many thin partings. Between these is a clay, 4 inches thick. Along the Buckhannon river the bed increases in thickness and shows remarkable changes in structure. Its thickness varies from 6 to probably 25 feet, but in this estimate is included the shale, of which there are many layers. In Upshur and Randolph counties I made many measurements, one of which is given here, as showing an extreme condition which prevails over a considerable area:

Upper Freeport Coal Bed.

Fig. 9.

*Upper Freeport Coal Bed.*

Giving barely 6 feet of all that, by any stretch of courtesy, can be called coal. Another exposure, in a total section of 18 feet, shows about 7 feet of coal, which is of all grades, from good to very bad. When the bed falls below 12 feet the coal is fair, but seldom such as is of commercial value. Beyond this to the Great Kanawha the bed has not been carefully traced, or, if it have been so traced, the results have not been published. On the Kanawha, it has been identified with a bed occurring at a short distance below the black chert, to which reference has been made. At Cannelton, on the Kanawha, this is known as the Stockton coal, and it is probably the same with the Peytona canal bed. Along the Kanawha it varies from 5 to 7 feet, and at all localities contains some cannel.

In the oil-break of West Virginia, this is the only one of the lower coal series which seems to be present, if we except the thin bed seen between it and the Mahoning sandstone, which, however, occurs at but one locality. Here, as at all other localities within the State, the *Upper Freeport* is a double bed, and its tendency to break up is shown in a cut on the Parkersburg branch of the Baltimore and Ohio railroad, where the section is—

Coal,	1' 3" to 1' 11"	} 10' 8"
Shale and sandstone,	6' 0"	
Cannel,	0' 10"	
Clay,	0' 3"	
Coal,	1' 8"	

The bed is quite as variable here as at any exposure already mentioned.

The Freeport limestone is by no means persistent. I have never seen it on Cheat river, though it is said to be present there. In Monongalia county, south from that river, it is represented only by a few calcareous nodules, but on the Baltimore and Ohio railroad, where the Tygarts Valley river issues from the mountain, the limestone is well shown near Nuzum's mills, and is 3 feet thick. Southward from this it was not observed until the Staunton pike was reached, in Randolph county, where at 50 feet below the *Upper Freeport coal bed* a limestone, probably 4 feet thick, is imperfectly exposed. Beyond this it was not seen; in the oil-break it is absent.

In the greater part of Monongalia county, the *Lower Freeport coal bed* is wanting, but in Marion county it was seen at Nuzum's mills, where, in my "Notes on the Geology of West Virginia," it is erroneously identified with the *Upper Freeport*. At this locality it certainly bears much resemblance to the upper bed, as that usually appears in this portion of the State, being double, and having a layer of cannel on top. Southward it seems to be quite persistent, and at the base of Rich mountain is 4 feet thick, 70 feet below the *Upper Freeport*, and yields a good, but somewhat soft, coal. With this bed Mr. Ridgway has identified a coal, which, at Cannelton, on the great Kanawha, is seen at a few feet below the *Upper Freeport*. It seems hardly possible that this identification can be accurate, for the intervals between the coals increase greatly in that direction. At all events it is uncertain, since the area between the Staunton pike and the river is still unknown.

Of the coals below the *Lower Freeport*, none in West Virginia has been satisfactorily identified with any in Pennsylvania, except the *Mount Savage* (?), which is the first above the Seral Conglomerate. Between these beds

there are several in the northern part of the State, and the number increases very greatly south from the Baltimore and Ohio railroad, so that on the great Kanawha river, above Charleston, Prof. Ansted found thirteen beds exposed on one stream, where neither the top nor the bottom of the series is reached. The Ferriferous Limestone is exposed at many localities in the extreme northern part of the State, and in earlier days it was used as an ore in the furnaces; but south from the Baltimore and Ohio railroad it is wanting, unless, indeed, the thin limestone 550 feet below the *Upper Freeport coal bed* on the great Kanawha river be the same. The Piedmont Sandstone (?) is a marked stratum in the northern counties, but south from the Baltimore and Ohio railroad it cannot be distinguished amid the great mass of sandstones, which hold the coal beds, and seem to be only a continuation of the Seral Conglomerate. It not unfrequently holds a thin coal bed.

The *Mt. Savage coal bed* (?) seems to be fully persistent, and is present at all localities where its horizon is exposed, except in the oil-break. At one exposure in Monongalia county, it shows a structure similar to that observed in Springhill township, of Fayette county, being in two divisions, separated by four feet of hard, flaggy sandstone, which was used as a firestone in the old furnaces of that region. At Nuzum's mills, on the Baltimore and Ohio railroad, it rests directly on the Seral Conglomerate, and is from 0 to 3 feet thick. Here it is often replaced by waves of a non-plastic fireclay, which may be the same with that obtained at *Mt. Savage*, in Maryland. On Rich mountain it shows a structure like that found in North Union township, of Fayette county, Penn., having three benches, 4, 42, and 19 inches thick, separated by clays, each one inch thick. On the Great Kanawha a coal bed is seen in this position.

The changes in West Virginia are but a continuation of those begun on the face of Chestnut hill, in Pennsylvania. As already shown, the limestones there are thin and irregular, and the fragmentary rocks are coarser than at the north-west. But the conditions show only slight alteration until the broad basin south from the Baltimore and Ohio railroad

is reached. There the series suddenly expands in thickness, the limestones disappear, and the rocks between the coal beds seem to be but a continuation of the conglomerate. The Freeport Limestone finally disappears near the Staunton pike, and at ten miles further south, a boring 478 feet deep, after passing 32 feet below the *Upper Freeport coal*, found nothing but sandstones of varying coarseness. The top 32 feet passed through shale. In this boring, four coal beds were found. On the Great Kanawha a thin limestone is seen at 550 feet below the *Upper Freeport coal bed*, but aside from this the rocks are almost wholly sandstone. Accompanying this increasing coarseness of material, there is an enormous expansion of the mass southward, so that the interval between the Mahoning sandstone and the conglomerate, barely 150 feet in Springhill township, of Fayette county, becomes not less than 700 feet in Randolph county, and fully 900 feet on the Great Kanawha.

The tendency to divide shown by the Upper Freeport, is characteristic of nearly all coal beds belonging to the Lower Productive Coal Series in West Virginia.

CHAPTER VIII.

The Pottsville (Seral) Conglomerate.

This mass is well exposed along the face of Chestnut hill from the Conemaugh to the southern line of the district, and thence through West Virginia to Kentucky and Tennessee, everywhere being the floor on which rests the Lower Productive Coal Series.

On Chestnut ridge within this district the Conglomerate nowhere becomes very imposing, and its thickness varies from 40 to 70 feet. It is well shown on the Conemaugh, the Loyalhanna, Jacobs creek, the Youghiogheny, and the larger streams southward in Fayette county. Northward from the Youghiogheny it seldom reaches the valleys, as the little streams rarely cut down so deeply as to expose this rock, and it can be seen for the most part only in the gaps made by the larger streams named above. South from the Youghiogheny, however, it approaches more nearly to the longitudinal valleys which stretch along the base of the mountain, so that in North and South Union townships, as well as in Georges, this rock forms the mountain face, and causes the steep slopes seen on so many of the projecting hills. On the Youghiogheny, Dunbar, Redstone, and Georges creeks its out-crop is at a considerable distance from the central line of the axis, but on Cheat river, in West Virginia, it is seen nearly two miles above, where it passes under the river and forms the surface rock at the locally celebrated Cheat view. On Deckers creek it crosses the arch, and at the gap made by the Tygarts Valley river it is the lowest rock exposed. Eastward from this it is not again seen until the main axis of the Laurel ridge is reached. Thence southward and on the two monoclinal ridges known as Rich and Cheat mountains it is conspicuous.

The thickness of the conglomerate increases southwardly. Within this district, as has been stated already, it rarely exceeds 50 feet. But on Cheat river the thickness is certainly

not less than 100 feet. On Deckers creek it forms bold cliffs through which the stream has cut a deep gorge, and its thickness cannot be less than 350 feet. Borings made along this creek passed through 300 feet of sandstone without reaching the bottom of the rock. One section shows 36 feet of shale in a thickness of 208 feet, while another of 300 feet shows only sandstone, mostly white and blue, though some layers are almost black. At the gap of Tygarts Valley river the rock is exposed to the thickness of about 100 feet. Along the face of Rich mountain, south from the gap of the same river, the mass is fully 600 feet thick, while further south, on the Great Kanawha, Prof. Fontaine finds it not far from 1200 feet.

The composition of the mass shows a great change southward. In Westmoreland county, as well as north from the Youghiogheny river, in Fayette, the rock is fine-grained and in no wise deserves the name of conglomerate. It contains fewer pebbles than one ordinarily finds in the Mahoning sandstone, and at many exposures there are no pebbles whatever from the top to the bottom of the rock. This is the condition in the gaps made by the Loyalhanna and the Conemaugh, where, except at the very base, the mass is a fine-grained and very handsome building stone, which splits readily and can be dressed easily. At the base it is still fine-grained but hard and irregularly bedded as though it were a half made quartzite. This portion contains much carbonaceous matter in the shape of stems whose bark has been converted into *coal*. On Jacobs creek it is but little coarser, while on the Youghiogheny, where the whole mass is well shown near the sand-works above Connellsville, pebbles are of rare occurrence, and the rock is simply a somewhat coarse-grained sandstone.

Southward from the Youghiogheny, the rock becomes coarser and pebbles are common, but no marked change appears until beyond the line of West Virginia, where the alteration is very distinct. Here the thickening begins, and with it comes increasing coarseness. Numerous pebbly layers are now seen, which grow thicker and coarser as the rock is followed southward. On Deckers creek the pebbles are

abundant, and in many cases are larger than a hen's egg. A similar condition exists at the Valley Falls, on the Baltimore and Ohio river railroad. But the pebbly layers do not yet predominate, for they alternate with thicker layers of fine-grained compact sandstone. On Rich mountain, however, the pebbly layers predominate, and one hastily glancing at the exposures on the Staunton pike might easily suppose that the rock is conglomerate throughout. On the Kanawha and its tributaries, as has been shown by Prof. Fontaine, the character of the rock is again wholly changed; for there he finds that a mass of sandstone, more or less conglomerate, and from 150 to 200 feet thick forms the top portion. Below this there is a succession of sandstone, shales, and *coal* beds, at the base of which there is another sandstone, 80 feet thick and quite conglomerate.

Along Chestnut ridge, within the Fayette and Westmoreland district, the Conglomerate shows no accumulations of vegetable matter, other than the rude collections of stems at the base on the Conemaugh and Loyalhanna. At some localities, near the southern line I was informed that a coal bed occurs within it, but this I could not find. It is more than likely that the statement is an error, due to mistaking the Piedmont Sandstone (?) for the upper portion of the Conglomerate, so that the coal bed is likely to be the *Mt. Savage*. (?) In Monongalia county, of West Virginia, no coal bed is exposed, yet the black sandstones mentioned in the records of borings, show that vegetable matter existed in large quantity, but that the conditions were not favorable to the formation of coal beds.

The most northern exposure of coal yet observed within the Conglomerate, seems to be on the Staunton pike, where it crosses the Rich mountain, in Randolph county, of West Virginia. There the blossom of a coal bed was seen at the roadside, on the eastern slope of the mountain, and at six miles further south, this bed was found to be 3 feet thick. On the Great Kanawha river this series has been carefully worked out by Prof. Fontaine, who finds nine coal beds, varying in thickness from 1 foot to 4 feet 6 inches. The

topmost of the series is mined at Quinnimont, on the Chesapeake and Ohio railroad.

In eastern Kentucky the Conglomerate is from 30 to 300 feet thick. At one locality in Greenup county, Mr. Lyon found the whole interval from the top of the Conglomerate to the Mountain limestone only 30 feet, while in the southeastern portion of the field Mr. J. Lesley found the Conglomerate itself about 300 feet, with the Umbral shales and the *Sharon coal group* below it. The thinning of the mass is toward the western border of the field. Where the formation becomes thick it is usually conglomerate, though occasionally it is replaced in part by a coarse ferruginous sandstone. Dr. D. D. Owen states, in his first report, that the Millstone Grit sometimes shows coal beds, which are never thick enough to be of any economical value. The great group of coals described by Prof. Fontaine as occurring on the Kanawha, has almost wholly disappeared in Kentucky, the sandstones alone remain, and these do not show such persistence as we might expect.

In Tennessee, Prof. Safford's sections, in divisions "A," "B," and "C," of the coal field, show the Conglomerate coals with the Umbral shales and the *Sharon* coals below. The two Conglomerates and the intervening coals, forming the upper coal measures of that state, simply repeat Prof. Fontaine's section on the Kanawha, the chief difference being in thickness. The details in division "D," do not seem to have been worked out, and the relations of the huge mass of coals and sandstones found there, above the lower conglomerate cannot be determined from the facts which have been obtained. A careful comparison of the sections given in the geology of Tennessee, leads me to regard the "Cliff Sandstone" as belonging to the lower conglomerate, so that the whole mass from the Cliff to, and including the upper conglomerate, belongs to the Upper Coal Measures of Prof. Safford, or the conglomerate series of West Virginia. The intimate relation of the "Cliff" and the lower conglomerate is shown by the fact, mentioned by Prof. Safford, that toward the east they unite to form one enormous bed.

The results of Dr. Little's survey in Georgia, will doubtless aid much in defining the relations of these rocks.

Little information exists respecting the conglomerate in Alabama. The conditions in the north-eastern part of the State, seem to be simply a continuation of those seen in Tennessee.

CHAPTER IX.

The Lower Carboniferous Series.

By Prof. H. D. Rogers the rocks of the Lower Carboniferous were separated into two groups, the Umbral and the Vespertine. These are exposed along the crest and higher portions of Chestnut Hill, from the Conemaugh to the Virginia line, and the upper part is reached in deep ravines made by the larger streams. Complete sections can rarely be obtained, though in Fayette county the greater part of the Umbral is finely exposed at many localities, where the ores of that group are mined. Vespertine rocks are shown on the crest of the mountain, but full measurements can be obtained only in the deeper gaps, and the only complete exposure is in the gap of the Conemaugh. Elsewhere the cover of debris is such as to cover the greater portion of the section, and to prevent satisfactory determination of details.

I. THE UMBRAL ROCKS.

These, the No. XI of Profs. H. D. and W. B. Rogers, consist of red shales with sandstones, iron ores, coal beds, and, at the bottom of all, a limestone, varying in character and thickness in the different parts of the district. They are well seen on the Conemaugh, the Loyalhanna, Jacobs creek, the Youghiogheny, and on nearly all of the larger streams of Fayette county. The following section shows the series as it appears in the northern portion of the district :

Fig. 10.

1. Pottsville, or seral conglomerate, —
2. Mauch Chunk red shale,	80'	..... 80'
3. Sandy shale, . . .		..... 2'
4. Blood red shale, . .	20'	..... 20'
5. Fossiliferous L.S., .		..... 2'
6. Blood red shale, . .	35'	..... 35'
7. Fossiliferous L.S., .		..... 1' 6"
8. Dark red shale, . .	15'	..... 15'
9. Calcareous sandst'e,		..... 2'
10. Clay, . . . . .		..... 1'
11. Calcareous sandst'e,		..... 1'
12. Dark red shale, . .	40'	..... 3'
13. Conglomerate, . . .		..... 3'
14. Siliceous limestone,		..... 40'

Umbra! Rocks.

Towards the south the Mauch Chunk shales contain some important iron ores which will be described in another chapter. These lie within the first 75 feet below the Conglomerate and are accompanied by thin coal beds, some of which are clearly persistent as far north as Jacobs creek, in Westmoreland county. For the sake of showing the relations of these beds the following section is introduced :

Fig. 11.

1. Pottsville (seral) conglomerate, . .		..... 15'
2. Red shale, . . . . .		..... 0' 6"
3. Coal bed, . . . . .		..... 0' 6"
4. Red shale, . . . . .		..... 0' 6"
5. Little Honeycomb ore bed, . . .		..... 2'
6. Shale and clayey sandstones, . .		..... 2'
7. Big Honeycomb ore bed and clay, .		..... 1'
8. Dark red shale, . . . . .		..... 0' 6"
9. Coal bed, . . . . .		..... 0' 6"
10. Clay, . . . . .		..... 1'
11. Coal bed, . . . . .		..... 0' 6"
12. Red shale, . . . . .		..... 12'
13. Kidney Ore bed, . . . . .		..... 0' 6"
14. Shale, . . . . .		..... 0' 6"
15. Coal bed, . . . . .		..... 0' 6"
16. Shale, . . . . .		..... 0' 6"
17. Coal bed, . . . . .		..... 0' 6"
18. Shale, . . . . .		..... 0' 6"
19. Big Bottom ore bed, . . . . .		..... 1' 6"

Umbra! Ores.

Of the coal beds Nos. 3 and 17 are found as far north as Jacobs creek ; most of the others seem to be persistent only as far north as the Youghiogheny river.

The interval between the Seral (Pottsville) conglomerate and the Big Bottom ore bed is from 60 to 80 feet in the central portion of Fayette county, and along the Youghiogheny river, but in Springhill township, of Fayette, the section is 7—KK.

compressed within a space of less than 30 feet, though some of the coal beds are missing. In Bullsken township, of the same county, but north from the Youghioghenny, the Big Bottom is almost directly under the Conglomerate, while on Jacobs' creek, near Laurelville, the interval between the two strata is very nearly 70 feet, whereas at a few miles further up the creek it is but 40 feet, with both the Honeycombs missing, and the first coal bed under the Conglomerate resting on the Kidney Ore, which is about 25 feet above the Big Bottom.

The shales in this interval are dull red, and usually somewhat micaceous. They show no remains of either animals or plants. Northward from Jacobs creek they become deeper red, and the ore beds, so persistent at the south, disappear. The increased redness of the shale may be due to the dispersion of the ore.

Below the horizon of the Big Bottom ore, the rocks are as variable as those above that bed. In the Loyalhanna section they consist almost wholly of red shales, but on the National road the red shale is in small quantity, and the greater part of the interval between the ore and the limestone is filled with flaggy sandstones. This seems to be the condition along the mountain face in Fayette county. On the National road, the distance from the limestone up to the Big Bottom ore is about 100 feet, while, on the Loyalhanna the whole interval from the limestone to the Conglomerate is little more.

The limestone at the base of the Umbral is as marked a feature of the group as are the red shales. In the Cone-maugh and Loyalhanna sections, this is siliceous limestone. In the former gap it is well exposed near the watch-house, where it is quarried for use as ballast. It is very compact, blue, breaks with conchoidal fracture, and in general appearance bears close resemblance to quartzite. It is said that when burned this rock yields a snow-white lime, which contains sand enough to make mortar for plastering inside walls. That it contains sand enough for this purpose is sufficiently clear, but that it has enough lime to make mortar is open to some show of doubt. When the rock is long ex-

posed to the weather, the limestone is washed out, and the sand remains as a friable coating on the outside. So great is the proportion of sand, that the removal of the limestone has no appreciable effect on the apparent mass, and the rock, thus weathered, seems to be a compact sandstone, until it is scraped by the hammer. The rock is essentially a sandstone, whose cementing material is calcium carbonate. The calcareous matter is easily removed, for in Pittsburg, where this material is used to some extent as a paving stone, I found that even the brief exposure, to which the stones had been subjected before they were put down, had proved sufficient to separate much of the limestone, so that a very distinct scale already showed itself on the surface.

Immediately above the siliceous limestone, there is a conglomerate in the Loyalhanna and Conemaugh sections. It is 3 feet thick, and contains large fragments of the limestone imbedded in fine limestone. It is absent from all exposures observed south from the Youghiogeny. On the Conemaugh, the rocks above the siliceous limestone are concealed, so that it is impossible to determine whether or not any representative of the fossiliferous layers is present there. But on the Loyalhanna, as may be seen by reference to the section, there are two layers of that rock 35 feet apart, the lower one being 25 feet above the siliceous limestone. These layers are quite thin, and are almost as siliceous as the great mass below, but they have not the pale blue color, and are stained with iron. They weather in the same manner, and eventually break down into a reddish sand. They contain some fossils of the more common species, which are represented by very poor specimens. The shales associated with these fossiliferous layers are of a remarkably deep red color. Further south there is a hematite ore, found near the limestone, and the blood red color of these shales is probably due to the dispersion of this ore. On the Conemaugh, the siliceous limestone is similar to that on the Loyalhanna.

South from the Loyalhanna, this portion of the series was not seen again until Jacobs creek was reached. The anticlinal flattens southward, so that here the Umbral rocks are very poorly exposed, even when touched in the ravines. On

Jacobs creek, the limestone is the lowest rock shown under the arch of the axis, and probably its full thickness was not seen. The exposed portion is about 40 feet thick, and is fossiliferous throughout. The top layers are very pure, and yield a lime of superior whiteness and general purity. The middle layers are argillaceous, occur in thin beds, and are extremely rich in fossils of many species. The bottom, of which only 2 feet were seen, is much like the top. The siliceous limestone, therefore, is not exposed. As that portion is present and thick at more southern exposures, it is, no doubt, present here, but below the surface. The exposed limestone occupies the place of the lower red shales, on the Loyalhanna. Above it, on Jacobs creek, the interval to the Big Bottom ore bed is filled with shales and sandstones, in about equal proportions.

On the Youghiogheny, the Upper or fossiliferous limestone is imperfectly exposed, but seems to be about 10 feet thick. Like the same rock on Jacobs creek, it is very pure, and contains many fossils. Between it and the siliceous limestone below, there is some sandy shale. The siliceous limestone shows no new features. Above Connellsville it is quarried for use as paving stone in Pittsburg.

Followed southward, the upper or fossiliferous limestone is found increasing in thickness, and separated by from 10 to 25 feet of clayey sandstone from the lower or siliceous limestone, which diminishes in that direction. On the National road, the upper portion of the mass is probably 30 feet thick, though owing to imperfect exposure the thickness could not be determined with accuracy. In general structure and composition this portion is as described on Jacobs creek, being very pure on top but becoming argillaceous below, so that the transition to the clayey sandstone is gradual. The siliceous limestone contains more lime than on the Loyalhanna or Conemaugh. It disappears near the West Virginia line, and the mass becomes limestone throughout, but varies much in the purity of its several portions.

UMBRAL ROCKS IN WEST VIRGINIA AND SOUTHWARD.

In West Virginia the general succession is the same as in south-western Pennsylvania. The Mauch Chunk shales are well exposed on Cheat river and Deckers creek where those streams cut through the Laurel hill of that State, which is the same with Chestnut ridge of Pennsylvania. They are well exposed also on the mountains at the east, and where the Tygarts Valley river breaks through Rich mountain they are rather more than 200 feet thick. Where the Staunton pike crosses the same mountain they are barely 50 feet. While at six miles further south, on the east side of that mountain, the shales are wholly wanting, and the Conglomerate rests directly on the Umbral limestone. In Pocahontas county, according to measurements made by Prof. W. B. Rogers, the thickness of this portion is 1,260 feet, and the rocks are sandstones and shales, the latter showing some calcareous matter.

In Kentucky and Tennessee this portion of the series is persistent, and contains coal beds, some of which are of importance. Along the whole line from Jacobs creek, in Westmoreland county of Pennsylvania, to the northern border of Alabama, these shales contain irregular beds of coal and iron ore, which at many places become of economical importance.

Immediately after passing into West Virginia the siliceous limestone seems to disappear, and the whole mass shows a composition similar to that observed on Jacobs creek. On Cheat river, as ascertained by a boring, the thickness is not far from 100 feet, and on Deckers creek the following section was obtained at about seven miles from the Monongahela river:

1. Limestone, flaggy, fossiliferous, 8'
2. Concealed, 12'
3. Limestone, dove-colored, compact, non-fossiliferous, . . 14'
4. Limestone, dull-gray, many fossils, 6'
5. Limestone, coarse, gray, compact, numerous indistinct fossils, 6'
6. Limestone, dark, impure, upper layers irregular, lower layers more compact, fossils numerous, 10'
7. Calcareous, lead-colored shale, 2' 8"
8. Limestone, argillaceous, 1' 6"
9. Shale, calcareous, breaking down into mud, 2' 8"
10. Limestone, gray, compact, non-fossiliferous, seen, . . . 8'

This section begins at about 20 feet below the top of the mass, and fragmentary outcroppings of limestone can be seen on the hill above. The base of the limestone is not reached by the section, and the thickness is clearly not less than 105 feet.

Southward from Deckers creek, the limestone is not exposed on this axis, as the fold rapidly flattens out, but on the axis beyond it toward the east, the limestone is well shown and exhibits a marked increase in thickness. On Rich mountain I measured 400 feet, below which is a concealed space of 200 feet, succeeded by calcareous shale fully 100 feet thick, so that the whole mass cannot be far from 700 feet thick. Further south the limestone shows a greater thickness, being, according to Prof. Rogers, 822 feet in Pocahontas county. . Interstratified with the limestone are layers of calcareous shale. This mass retains its importance southward, being very thick, both in Kentucky and Tennessee, as well as in Alabama. In Ohio it was discovered by Prof. E. B. Andrews, of the Ohio survey, but only fragmentary areas remain, and it was not found in the first district of that State.

In 1870 I submitted to Mr. Meek some fossils which I had obtained from this limestone on Cheat river, near Ice's ferry. These were found by him to be forms closely related to those of the Chester group at the west, and several species were identical. The Maxville limestone of Prof. Andrews, in Ohio, proved to be of the same age. The fossils found in Fayette and Westmoreland counties of Pennsylvania, are the same with those obtained on Cheat river. In Randolph county, of West Virginia, I made careful search for fossils at 400 feet below the base of the red shale, but was unable to find any but those of the Chester. For a long time I had had in my possession a specimen of *Lithostrotion*, which was said to be from that county, but failing to find other specimens there, I concluded that my specimen was a stray one from some of the Western States. Last summer, however, Prof. Fontaine gave me a specimen of *Lithostrotion* which he had obtained in the vicinity of Lewisburg, in Greenbrier county, of West Virginia. This

is sufficient evidence that rocks of St. Louis age may yet be found in West Virginia. A list of the fossils found in this limestone will be given in another chapter.

THE SHARON COAL GROUP.

The coal beds of the Upper Umbral, to which Prof. Rogers, in the report on the first Geological Survey of Pennsylvania, gave the name of *Sharon group*, are so much more extensive than was supposed, that they deserve notice beyond that already given in the previous portion of this chapter.

Within the Fayette and Westmoreland district, the coals of this group were not found north from Jacob's creek, but the place of disappearance could not be determined, as, for the most part, the country between that stream and the Loyalhanna is a wilderness, and no exposures of the Umbral were found. On the Loyalhanna no coal occurs, and the exposure between the Limestone and the Conglomerate is complete; but on the Conemaugh, some black or coaly shales were seen, which evidently represent these coals. For this reason I am inclined to think that the absence of the group on the Loyalhanna is purely local, and that it is more or less persistent north from the Conemaugh.

The *Sharon coal bed* may be the northern representative of the group. The change in the composition of the Conglomerate northward has led some most excellent geologists to look upon that bed as belonging to the Lower Productive Coal Series. Details respecting this group between Sharon and the Conemaugh are still inaccessible, as no reports have been published giving information regarding that region, and the name of the group is retained only provisionally.

On Jacobs creek, east from the plane of the Chestnut Ridge axis, two coals are exposed in the bank of the stream which seem to be the Nos. 3 and 17 of the second section. The upper of these is thin, only 8 inches, and lies directly under the Conglomerate. The other, which at one locality is 65 feet, and at another only 25 feet below the upper, is associated with the Big Bottom ore bed. Above Laurelville, on this creek, it is 18 inches and single, showing no

partings whatever. Near the saw-mill on the same creek, and several miles further up, its blossom only was seen, and the thickness of the bed was not determined ; but at a mile or two above it was found 3 feet thick and yielding a good coal. On the top of the mountain this bed was once mined, alongside of the pike.

On Mount's creek, all the coal beds seem to be missing, as the interval between the Conglomerate and the Big Bottom ore has practically disappeared. But a thin coal is seen in the Conglomerate at 3 feet from the base, which may belong to the Sharon group. On the Youghiogheny these beds are no longer exposed, but they are present, as was ascertained when the ore beds were mined.

In Dunbar township, of Fayette, this group shows four beds of coal, the first under the Conglomerate, the second under the Big Honeycomb ore, the third under the Kidney ore, and the fourth at about 12 feet above the Big Bottom ore. That immediately below the Conglomerate sometimes becomes 1 foot thick, but the others never exceed 6 inches. At the Lemont mines, in North Union township, there are five beds, the additional one being caused by the division of that underlying the Big Honeycomb ore. These are all thin, the thickest, that first above the Big Bottom, being only from 8 to 10 inches thick. The highest bed is 15 feet below the Conglomerate. In Springhill township, at the Springhill mines, there are only two beds, one immediately below the Conglomerate, varying from 1 foot to 14 inches, and the other below the Big Honeycomb, 15 inches thick. These coals afford a bearing-in to the miners, and in some cases are used for calcining the ore.

In northern West Virginia the coals of this group are very insignificant. I have never seen any of them, and Prof. W. B. Rogers, in his report for 1840, says that the mass of red shale is destitute of any but thin coals which are only of local extent. No coal seems to be present in the shales of Rich mountain, but further south in the region of the Great Kanawha river, both Prof. Rogers and Prof. Fontaine make mention of a coal bed in the shales directly below the conglomerate.

In the eastern coal field of Kentucky the Sharon group is persistent, and contains two coal beds, each of which is locally of workable thickness. The same group is found in Tennessee, where it forms the lower coal measures of Prof. Safford's report. In Alabama, the most important coal beds belong to this group, as is shown by Prof. Lesquereux, in his discussion of coal plants, placed in his hands by Prof. Smith.*

There seem to have been two eras of coal-making in the Umbral, for in Randolph county, of West Virginia, a thin coal bed was found within the limestone, and in Kentucky, according to D. D. Owen, there are thin coal beds in the Mountain limestone. No such beds are reported from Tennessee by Prof. Safford, or from Alabama by Prof. Smith.

II. THE POCONO (VESPERTINE) ROCKS.

Within this group, the No. X of Prof. Rogers' list, I have included all the rocks, which, in this district, are exposed below the Umbral limestone. At some localities these rocks undoubtedly reach down to No. IX, but the two groups seem to pass into each other so gradually in all gaps where exposures occur, that any separation, in the absence of fossils, must be arbitrary to the last degree. Within the limits of this district the two groups, IX and X, so far as yet known, appear to form but one series.

The column is not fully exposed at any locality, and the best section is that found in the Conemaugh gap, but the rocks are fairly well shown along the crest of the ridge between the Conemaugh and the Loyalhanna, as well as between the Youghiogeny and the West Virginia line. Rocks still lower than any shown in the Conemaugh section were reached in a boring made just south from the National road, where the limestone at the base of No. IX was passed through and found to be about 50 feet thick. The section, as exposed in the Conemaugh gap, is as follows:

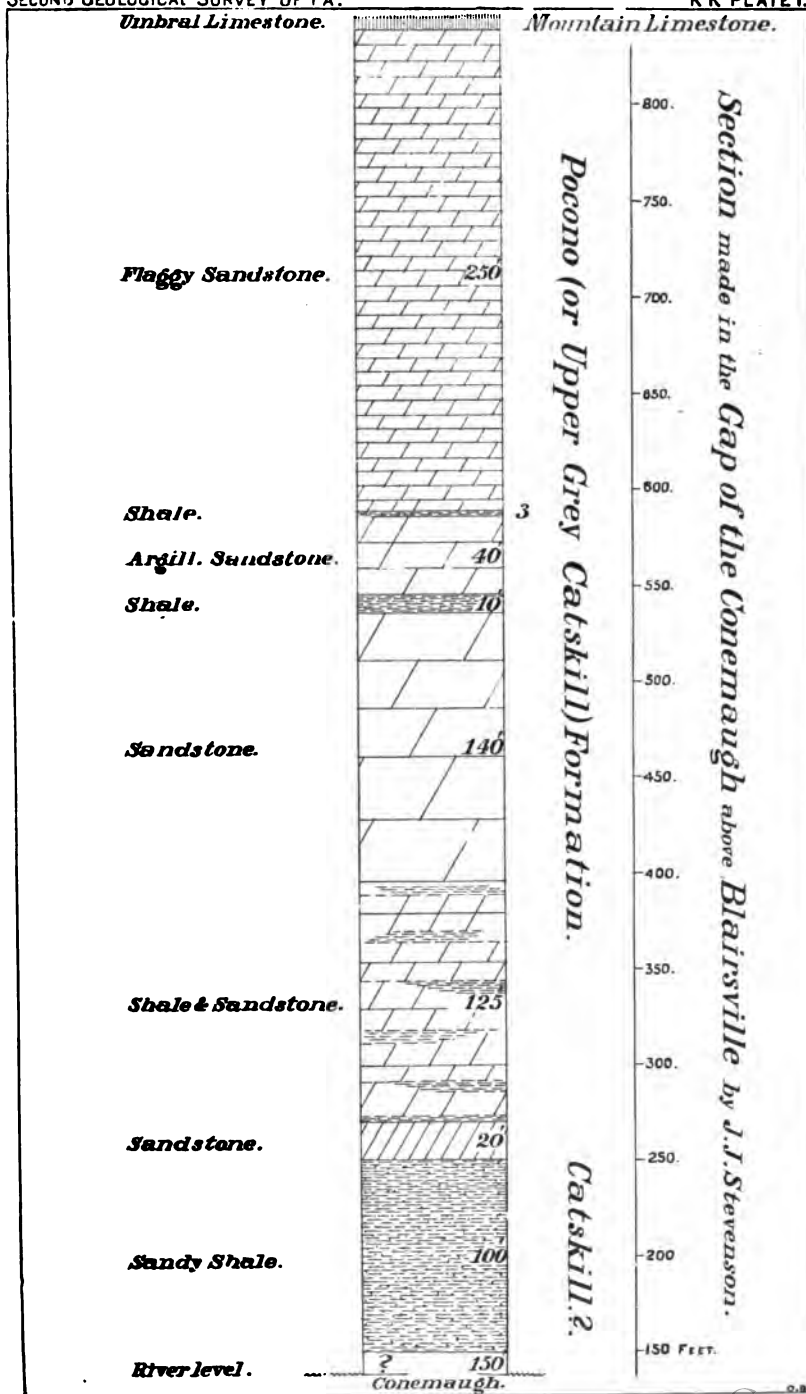
* A letter from Prof. Smith, received since this paragraph was written, states that the molluscan remains are wholly those of the Coal Measures, and that Prof. Lesquereux's conclusion is hardly supported by the stratigraphy.

106 KK. REPORT OF PROGRESS. STEVENSON, 1876.

1. Umbral limestone,	—
2. Flaggy sandstone,	250'
3. Shale,	8'
4. Argillaceous sandstone,	40'
5. Shale,	10'
6. Sandstone, conglomerate toward the base,	140'
7. Shale and sandstone,	125'
8. Sandstone with conglomerate layers,	20'
9. Sandy shale,	100'
10. Concealed to the river,	150'
Total,	888'

In this section the portion from No. 2 to No. 6 inclusive, may be regarded as a single mass of sandstone, since the two layers of shale are very far from being constant. At other places they are found higher or lower in the section, so that they are probably such shales as are always seen in some portion of every great sandstone. The upper part of this mass is a flaggy sandstone, and shows cross-bedding throughout. No. 4 is quite argillaceous and yields readily to the action of the weather. The lower sandstone, No. 6, is compact and such as would be a good building stone, though it is apt to show a shattered surface where it has been long exposed to the weather. This feature is fully exhibited here, and at several points the railroad company have been compelled to build strong walls of masonry under projecting portions to prevent disastrous falls. The upper sandstone is quite fine-grained, but the lower one shows a marked tendency to become conglomerate, and layers containing large pebbles are quite characteristic of the mass. No such layers were seen here in No. 2. The exposure of this portion of the section is complete.

Below this sandstone, which is about 450 feet thick, there is a succession of shales and sandstones, No. 7, which is wholly characterless. This portion is not fully shown and there may be rock of some other sort in the concealed portions though the exposure seems to be sufficient to justify one in regarding the whole as consisting of only shales and sandstones. Below this comes a very curious conglomerate sandstone, which is so marked that, once seen, no other rock in the series can be mistaken for it. It has a peculiar greenish tint and holds layers of conglomerate, one of which,



near the middle, is about 10 inches thick and seems to be thoroughly persistent, having been observed wherever this stratum is exposed. Below this are red shales containing a few layers of reddish sandstone. This portion of the section probably belongs to No. IX, and the sandstone, No. 8 of the section, might be taken conveniently as forming the base of X, or the top of IX. The shales are of alternating hard and soft layers, so that the weathered surface has a fretted appearance.

In the Loyalhanna gap the section is badly exposed, but the great sandstone is seen rising from the bed of the stream at barely half a mile above the mouth of Miller's run, and seems to be quite as thick as on the Conemaugh. The shaly portions of the mass are concealed in this gap.

Along the crest of the mountain, between the Conemaugh and the Loyalhanna, the Vespertine rocks are frequently exposed, but for the most part the covering of detritus is so thick that only the great sandstone can be seen. Southward from the Loyalhanna to nearly midway between Jacobs creek and the Youghiogeny the Vespertine rocks are not shown, but thence to the river, exposures are by no means unfrequent. The section on the Youghiogeny seems to be not materially different from that seen on the Conemaugh. The same red shales occur and the curious sandstone, No. 8, of the Conemaugh section, is shown in fragments near the central plane of the axis.

On the National road a very fair exposure of the Vespertine rocks is given. The great sandstone is seen at the Turkey Nest, where it is thin-bedded, very light gray, and dips at an extraordinary angle. It is fine-grained, and is evidently quite as thick as on the Conemaugh, but this cannot be determined by direct measurement, as the exposure will not admit of that. Following the road, one sees the underlying shale and sandstone shown on the Conemaugh, while near the summit of the mountain the conglomerate, No. 8 of the Conemaugh section, is well exposed at the roadside, and some of the red shales are shown below it.

In a boring made by Mr. I. Hutchinson on a branch of Redstone creek, a *coal bed* was found at 53 feet below the

Umbral limestone, and 3 feet thick. This should be found near the Turkey Nest on the National road, but unfortunately the whole interval for somewhat more than 200 feet is concealed, as a ravine comes down there, whose sides are deeply covered with debris. This interval is well exposed on the Conemaugh, but no coal bed was seen. At the same time, the record of Mr. Hutchinson's well was kept with such scrupulous care that there is no reason whatever to doubt the existence of this coal bed, though it cannot be seen at the surface on the hillside. It is certain, however, that north from this line no coal occurs in the Vespertine sandstone, for that rock is well exposed on the Conemaugh, the Loyalhanna, and the Youghiogheny, at all of which localities the coal is wanting.

From the National road southward, the Vespertine rocks are at the surface on the crest of the mountain, which, from the Youghiogheny southward, is known as Laurel hill. In Georges township the sandstone is very fine-grained at all exposures, and in its mode of weathering closely simulates limestone.

On Cheat river, in West Virginia, this series has the same character as in Fayette county of Pennsylvania. From that river southward, exposures are few east from the axis representing the Negro mountain and the Alleghenies of Pennsylvania. Its sandstones are seen in the anticlinal valley made in that axis by the Tygarts Valley river. At Lewisburg, a coal bed 4 feet thick occurs in the middle of the group. Further toward the south the great Vespertine mass seems to disappear as a distinct group, and to be merged into the protean or lower member of the limestone series of Kentucky and Tennessee.

In southern Ohio the Vespertine group is represented by the Waverly group, which there underlies the Maxville limestone. At many places the rock contains pockets of loose ferruginous sandstone, which hold numerous fossils. Similar pockets were found by Prof. Fontaine in Virginia, in the vicinity of the Chesapeake and Ohio railroad, and the Virginia fossils which Prof. Fontaine placed in my hands bear a close resemblance to those obtained in the

Vespertine of Licking county, Ohio. Some of the species seem to be identical, though owing to the degree of decomposition, and the consequent imperfection of the specimens, one can hardly come to a definite conclusion respecting identity. Enough, however, is shown to prove that the relation between the species is very close.

Aside from the coal bed found in Mr. Hutchinson's boring, there is nothing of economical importance in the Vespertine rocks of the Fayette and Westmoreland district.

A layer has been found which contains some lead and zinc. The locality at which the material was discovered seems to be known to but few persons, and to be in a very secluded portion of the mountain. On each of the occasions when I attempted to find it, I was unable to procure a guide. The owner of the property, who was anxious that the value of the material be carefully determined, was at each time engaged at a distance from his house, and his presence could not be secured. But the economic value of the ore, so far as can be judged from hand specimens, which were said to be fair average samples, is not great. It occurs in strings varying from one sixteenth to one fourth of an inch thick. The quantity may be considerable, but the mode of occurrence is such that to obtain the ore would be costly. When obtained, it is likely to prove almost worthless. One analysis is said to show a large proportion of silver, but the proportion should be large to admit of profitable reduction. This band of lead-zinc ore is doubtless of considerable extent along the axis, for since the close of the season, a newspaper account states that silver-lead ore has been discovered, in large quantity, near Cheat river, in West Virginia. From all the indications, there is little reason to hope that this will prove valuable.

CHAPTER X.

THE IRON ORES.

The ores of Chestnut ridge, as shown in the vicinity of Cheat river, West Virginia, were described and classified in 1854 by Prof. W. B. Rogers, who recognized the following groups :

1. The Big Coal Group.
2. The Snake Den Group.
3. The Norris Group.
4. The Stratford Group.
5. The Martin Group.

The same grouping prevails through the Fayette and Westmoreland district. But as Prof. Rogers used only local names, those of pits on the property examined, and applied them merely for convenience of description, it may be well to employ a nomenclature of more general application. For this reason the following arrangement is proposed :

1. *The Pittsburg ores*, including the several bands of ore occurring within a space of 25 feet below the *Pittsburg coal bed*.

2. *The Johnstown ores*, embracing those occurring in the interval between the Green Limestone and the Mahoning Sandstone.

3. *The Freeport ores*, or those found between the Mahoning sandstone and the Piedmont (?) Sandstone.

4. *The Mt. Savage ores*, or those associated with the *Mt. Savage (?) coal bed*, lying between the Piedmont (?) Sandstone and the Seral (Pottsville) Conglomerate.

5. *The Umbral ores*, including the interesting and very persistent group found within a space of from 50 to 80 feet below the Seral Conglomerate.

The first, third, and fourth of these groups are named from the beds of coal with which they are associated, while the second receives its name from the locality in Cambria

county, where the principal bed attains great economical importance. The fifth is the celebrated ore group, on which the furnaces along the base of Chestnut ridge depend so largely.

1. THE PITTSBURG COAL ORES.

In the Blairsville trough this group has four principal bands of ore, known as the Blue Lump, the Big Bottom, the Red Flag, and the Yellow Flag. At many localities, there occurs between the first and the second an uncertain ore bed, known as the condemned flag, which is often good, but the quality is too variable to be depended on. The group may be tabulated as follows :

1. <i>Pittsburg coal bed</i> ,	—
2. Clay,	2' to 8'
3. Blue lump ore,	1' to 6" to 0"
4. Clay,	1' 6" to 4"
5. Condemned flag ore,	1' to 0"
6. Clay,	2' 6" to 4"
7. Big Bottom ore,	1' 8" to 1'
8. Clay,	5' to 10"
9. Red flag ore,	2" to 6"
10. Clay,	8' to 1'
11. Yellow flag ore,	4"

This section shows the variations south from the National road, but north from that the change is so great that no comparative section can be constructed, and the localities must be described separately.

Of the several ores, the Blue Lump is the most celebrated, and is by far the best in quality. It has a peculiar bluish-red tint, is quite compact, and of remarkable purity. It occurs in flattened nodules, which sometimes weigh several hundred pounds, and at some localities are so closely packed together as to form an almost continuous layer. The other ores are plates. In the Lisbon trough, this group seems to exist only along the Monongahela river, from the mouth of Cheat to that of Cats run, and for a few miles along the eastern outcrop of the *Pittsburg coal bed*. The Blue Lump, at least, is present as far north as the middle of German township, for lumps of it were seen at Capt. Kendall's coal bank, in that township. Along the river, the ores seem to

be altogether different from those given in the section, and hold a position similar to that of the beds seen at and north from Lemont furnace, in the Blairsville trough. On the western side of the Lisbon trough the whole group is absent, for at Brownsville, and below that on the river, hardly a trace of ore can be seen.

In the vicinity of New Geneva, on the Monongahela river, in the Lisbon trough, the Blue Lump is at the maximum distance below the *Pittsburg*, and at 4 feet below the coal, is a new bed, averaging not far from 2 feet, which is persistent around a large area, near the village. At the mouth of Cats run, four miles below New Geneva, three ore beds were seen, all of which are mined. The topmost layer begins at 3 feet below the coal, and consists of lump ore distributed through 3 feet of clay. At 3 feet lower is another clay, 2 feet 6 inches thick, closely packed with nodular ore, while, at 6 feet lower, there is an irregular layer of hard lenticular nodules, which are said to be inferior to the higher ores. The ore throughout is nodular, and the bottom layer is certainly very like the Blue Lump in shape and color, though evidently of rather poor quality. The upper layers are clearly the same with the ore seen near New Geneva, on Judge Crow's farm.

The Cats run ores are good, and, at the time of examination, they were digged for shipment to Wheeling, West Virginia, where they brought a price which the miners thought to be remunerative. Specimens of the New Geneva ore were analyzed. The following is an analysis of a sample taken from the outcrop. (A. S. McCreath.)

Carbonate of Iron,	24.860
Carbonate of Manganese, . . . . .	.599
Alumina,	2.092
Carbonate of Lime,	43.250
Carbonate of Magnesia,	6.228
Sulphur, . . . . .	.199
Phosphorus, . . . . .	.114
Carbonaceous matter,	1.150
Insoluble residue,	20.500
Water and undetermined,	1.008
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	100.000

Another specimen from the same property was obtained

in a trial pit, sunk at the end of a coal tunnel, 700 feet long. It seems to be a remarkably good ore, as appears from the following analysis by Mr. A. S. McCreath:

Metallic Iron,	33.350
Sulphur, . . . . .	.155
Phosphorus, . . . . .	.072
Silica,	13.860

This extreme variation is possibly due to the different conditions of the specimens, and it is more than likely that the latter analysis shows the true character of the ore. If so, this is one of the best in the whole group, for though some of the others excel it in percentage of iron, yet none of them shows less phosphorus, and certainly none of them can compare with it in quantity, or in the ease with which mining can be carried on. It should yield an iron, not inferior to that manufactured for so many years at Fair Chance furnace by Mr. F. H. Oliphant.

In Springhill township, of Fayette county, the Pittsburg ores cross the Saltsburg axis, and the Blue Lump is readily traceable along Georges creek, from the vicinity of New Geneva to near Fair Chance furnace, in the Blairsville trough. But in the meantime, the top bed at the former place has disappeared, and the interval between the coal and the Blue Lump becomes only 5 feet at Fair Chance, where that ore shows its typical character, and is 6 inches thick. At that furnace, it was used for fully fifty years by Mr. Oliphant in making the celebrated iron, which gave so high reputation to the Fayette county furnaces. From Fair Chance, the bed can be traced continuously, being mined at Mr. Oliphant's new furnace, in Georges township, also on Dr. Fuller's property, in South Union, as well as by Mr. Beattie and the Lemont Furnace Company, in North Union. It retains its thickness well until within a short distance north from the National road, when it begins to thin out, so that at Lemont furnace it is no longer thought to be of any value. In the bottom, between the furnace and the ore pits, this ore has been benched, and there it seems to be quite as good as at any other place within the district, but when followed under the hill it becomes too thin to be of any value.

On the west side of the Blairsville trough, the Blue Lump seems to be persistent, at least, as far north as the National road, having been found on both sides of that road, but at the localities where it has been opened, it is hardly so good as it is on the eastern side. Analyses of specimens of this ore from Oliphant's new furnace and from Dr. Fuller's property were made, which yielded as follows, the order being as given: (A. S. McCreath.)

Protoxide of iron,	49.500	46.871
Sesquioxide of iron, . . . . .	.700	8.285
Bisulphide of iron, . . . . .	.020	.084
Protoxide of manganese,	1.636	1.311
Oxide of cobalt,	—	Trace.
Alumina,	1.153	1.606
Lime,	1.859	1.740
Magnesia,	2.018	1.001
Sulphuric acid,	Trace.	.057
Phosphoric acid, . . . . .	.204	.161
Carbonic acid,	34.900	31.790
Water,	1.395	1.727
Carbonaceous matter, . . . . .	.730	1.040
Insoluble residue,	5.790	4.415
Total,	99.905	99.838
Iron,	39.000	42.116
Sulphur, . . . . .	.011	.041
Phosphorus, . . . . .	.089	.070

The flag ore, under the Blue Lump, No. 5 of the section, is quite persistent. At Fairchance, it was called the Condemned Flag, because of its sudden and great variations in quality. It is easily traced along Georges creek, being present at Fairchance, Oliphant's new furnace, absent on Dr. Fuller's property, but present on Mr. Beattie's property, just north from the National road, where it is mined. Beyond this locality it was not seen, and probably disappears, for it was not identified at any place where its horizon is exposed. On Mr. Beattie's property, it is from 4 to 7 inches thick, and seems to be made up of lenticular nodules, overlapping and crushed together, so as to form a continuous layer. It is laminated, and contains some coal.

The Big Bottom is co-extensive with the Blue Lump, in the Blairsville trough. In the Lisbon basin it is absent, except near the West Virginia line. This bed is mined at

Fairchance, Oliphant's, Fuller's, and Beattie's. At all these localities it is compact, varies from 10 to 18 inches, and is an excellent ore, though usually slightly inferior to the Blue Lump. An analysis, by McCreath, of a specimen from Oliphant's furnace, yielded the following result:

Iron,	35.500
Sulphur, . . . . .	.145
Phosphorus, . . . . .	.042
Insoluble residue,	7.450

The other ores, the Red and Yellow Flag, were seen only south from the immediate vicinity of the National road, along the eastern outcrop of the coal. These are always mined where the cover of earth is sufficiently thin to repay stripping. Their character is shown by the following analysis by McCreath:

Iron,	35.800	35.400
Sulphur, . . . . .	.047	.319
Phosphorus, . . . . .	.083	.069
Insoluble residue,	9.560	10.450

Northward from Lemont furnace, the whole of this series seems to disappear, and their place is taken by another set of beds, which hold a position like that of the beds seen on the river, below New Geneva. The sections at Frost's station and Dunbar are as follows:

1. Clay shale,	8'	2'
2. Ore bed,	0' 9"	0' 11"
3. Clay,	1'	0' 3"
4. Ore bed,	0' 10"	0' 3 to 4"
5. Clay,	0' 2"	2'
6. Ore bed,	1' 3"	0' 3"
7. Clay,	—	1' 2"
8. Ore bed,	—	0' 1"

Section one is no longer exposed, and the details are given on the authority of Mr. Frost. No. 2 of this section is a very fair lump ore and bears much resemblance to the Blue Lump, though evidently inferior to it in quality. No. 4 is brown and clayey, while No. 6 is a decidedly inferior material. Both of these are plate ores.

The same series of ores are seen at Lemont furnace, only a little way south from this station. There the interval between the coal and the highest layer is less than at Frost's,

but the upper two layers are of about the same thickness and somewhat the same general character. At Dunbar the ore shows a great change in appearance. Nos. 2 and 4 are mined. These resemble a dull brown clay, as unpromising material as was ever called iron ore. For several hundred feet under the hill, it is only a mud, but at the end of the drifts it has changed to a brownish rock. Though apparently so unpromising, this is an excellent ore, rather lean, but easily worked in the furnace and making a very fair metal. The ore No. 6, at Dunbar, certainly suggests the Blue Lump and its associations. For one foot above it, the shale contains much ore in plates, as is sometimes the case with the Blue Lump. The following analysis, by Mr. D. McCreath, shows the nature of the ore at Lemont :

Protoxide of iron,	37.542
Protoxide of manganese,	0.790
Alumina,	2.655
Lime,	3.390
Magnesia,	3.012
Sulphuric acid,	1.037
Phosphoric acid,	0.613
Carbonic acid,	23.180
Carbon,	2.690
Insoluble matter,	19.240
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	99.139

Iron,	29.200
Manganese,612
Sulphur,415
Phosphorus,268

Calcined ore from these mines yielded :

Iron,	54.800
Sulphur,	1.652
Phosphorus,	0.171
Insoluble matter,	7.920

According to Mr. Pechin, the Dunbar ore contains about 30 per cent. of iron with 1.11 per cent. of sulphur and 0.44 per cent. of phosphorus.

Northward from Dunbar these ores rapidly thin out, so that at Connellsville, on the Youghiogheny, they have disappeared. On the west side of the trough on this river, the ore is said to have been seen near Broadford, at the

Jackson mines, where it was once mined, but the quantity was inconsiderable. North from the river, along the eastern outcrop of the *Pittsburg coal bed*, the ore is present in petty quantity, as far as the southern portion of Westmoreland county, but thence to the northern outcrop of the coal no ore was found at this horizon, except in the shape of occasional nodules. A small amount was seen under the coal at the western outcrop on the Pennsylvania railroad.

In the Greensburg basin, there are some little local deposits of ore under the *Pittsburg coal*. Ores belonging to the Pittsburg group were frequently seen in Greene, Washington, and Allegheny counties, but never in quantity sufficient to be of economical value. In West Virginia, the Pittsburg ores have a very limited range, and even where they are known to occur, little has been ascertained respecting them. Prof. W. B. Rogers states, that the Blue Lump is seen in the peninsula, between Cheat and the Monongahela, at about six miles from the State line, where it is 6 inches thick. The same ore occurs under the coal near Morgantown, and on Scotts run, which enters the river below Morgantown, the quantity is considerable. But this seems to be its extreme southern limit, since it has never been seen at any point further south. At Fairmont it is absent, and at the many openings near Clarksburg there is no evidence of its presence.

The question arises, are these ores persistent within the region described? From the available information one can answer this question with some degree of confidence. For the most part they have been mined only on the outcrops, but it is certain that they are persistent along the eastern outcrop of the *Pittsburg coal bed*, in the Blairsville trough, from Cheat river almost to the Youghiogheny; on the western outcrop in the same trough to some distance north from the National road; that they cross the Saltsburg axis, in the southern portion of Fayette county; are readily traced across that axis along Georges creek, and are found on the eastern side of the Lisbon trough for ten or twelve miles. At Lemont, Dunbar and New Geneva, they show no signs

of diminution at a distance of 700 or 800 feet from the outcrop.

The ore-bed directly under the coal at Geneva, and the flag ores elsewhere above and below the Blue Lump, are likely to prove constant, since they are original layers and belong to the section as positively as do any of the limestones or coal beds. They are liable to such variation as is common to all the strata, and are likely to prove constant within the limits described. Respecting the Blue Lump, one cannot speak with equal confidence. This occurs in lumps, never in flags. It has been benched over an enormous area in the southern portion of the county, and for fifty years it was the principal source of supply for Fairchance furnace, where the daily yield of iron, during thirty-five years, was from six to ten tons. The nature of the ore, however, is such as to lead one to suspect that it is of later origin than the others, that it is not an original stratum, but the result of comparatively recent operations.

But be the origin and nature of these ores what they may, the supply is undoubtedly enormous. Granting that the utmost limit of the ore is only a little beyond the end of the longest tunnel yet driven, we find within Fayette county and the adjoining portion of West Virginia not less than seventeen square miles of ore-ground thoroughly tested. If we regard the average thickness as being only one foot, there are here about 52,000,000 tons of ore within sight and belonging to the Pittsburg group alone. But as a reference to the sections given in the body of this report will show, this estimate is far too small; for at no locality is the exposed ore only one foot thick. There is also every reason to suppose that this ore-group underlies fully two thirds of the Upper Coal area between the Youghiogheny and Georges creek, in the Blairsville trough, the whole of that area in Springhill township, as well as a very considerable portion of Nicholson township. In a large part of Springhill it can be benched, and in the remaining part the belts are so narrow that the ore is readily accessible everywhere.

Between the *Pittsburg* group and the Green Limestone there are several irregular bands of ore which are supposed

by their owners to possess great value. Some of these are found at widely separated localities, but always show the same character. Specimens obtained from two of these on Georges creek were analyzed with the following results (D. McCreath.)

Iron,	3.600	30.200
Sulphur,	0.117	.001
Phosphorus,	0.090	.192
Insoluble residue,	19.295	17.120

The latter of these is a 6-inch bed, seen also on the river bluff below New Geneva, and is 115 feet below the *Pittsburg coal bed*. It seems to be the only one which can possibly prove valuable.

2. THE JOHNSTOWN ORES.

Between the Green Limestone and the Mahoning Sandstone are some bands of ore, of which two attain local importance. The upper of these is the Snake Den ore, which was seen on Georges creek, near Crow's mill, on Cove run, above Lemont furnace, and is known by this name at both Springhill and Fairchance, as well as in the neighboring portion of West Virginia. At Crow's mill it seems to be a very fair gray carbonate, and is in a compact layer from 8 to 14 inches thick. It is distinctly marked on both sides of the creek, and is visible for more than a mile. Mr. Crow stated that forty years ago this was mined and carried to Springhill furnace, where it is said to have proved very good. But the analysis of a specimen yielded as follows, which does not confirm the popular belief respecting the excellence of the ore:

Iron,	11.600
Sulphur,	0.201
Phosphorus,	0.101
Insoluble residue,	62.080

On Cove run, in North Union township, of Fayette county, the same ore has been mined by benching, on the property of Mr. A. D. Ewing, and has been tried at Lemont furnace. In the vicinity of Springhill furnace it is one foot thick, and seems to be quite good, as appears from the following analysis, by Prof. Chandler:

Iron,	32.20
Phosphorus,	0.20
Insoluble residue,	9.85

But its quality is sufficiently variable, for a specimen from near Fairchance showed :

Iron,	5.82
Phosphorus,	0.28
Insoluble residue,	15.48

The proportion of phosphorus remains nearly the same, while the iron is greatly diminished.

Resting almost directly on the Mahoning Sandstone is a calcareous ore, which is persistent throughout the whole district, though it shows extreme variations both in quantity and quality. On the Conemaugh river, under the Saltsburg Axis, it is a ferruginous limestone, with nodular ore on it. Under the same axis, it is concealed on Sewickley creek, but is exposed on Jacobs creek, where it has been mined. On the Youghioghenny its horizon is concealed, and, southward from that river, is reached again on the Redstone, where it is worthless.

Along the face of Chestnut ridge, this ore, which is the same with that at Johnstown, and is known as the Johnstown Ore, is of much greater importance, but it is uncertain in its occurrence north from the Youghioghenny river. On Jacobs creek, east from the axis of Chestnut ridge, yet west from the topographical summit, it is thick, and found on many farms. Many years ago it was benched extensively here to supply the old Mt. Pleasant furnace on Jacobs creek. At Dunbar, it seems to be represented only by a ferruginous clay, which contains much disseminated ore. On Cove run, it has been mined as the "Limestone Ore," and an opening near the Lemont company's tramway shows the thickness to be about two feet. Two openings on the estate of that company, nearly a mile apart, show the same thickness. Tests at the furnace prove this to be a fair ore. At a little way north from the National road, in North Union township, Mr. Beattie has the same ore 2 feet 6 inches thick. Benching was attempted on this property, but the lumps were too large to be removed without the aid of machinery, and the work was temporarily abandoned.

On Redstone creek, in South Union township, this bed is exposed on Mr. Simmons' property, where it shows four layers of ore, in all 1 foot 10 inches thick, distributed through 5 feet 2 inches of clay. Ore from this locality has been tried at Mr. Oliphant's new furnace, but was not thought to be very valuable.

In Georges and Springhill townships, this is known as the Hardman Ore, being thought the same with that used at Mr. Hardman's furnace, in Preston county, of West Virginia. At Springhill, it is but a ferruginous limestone, and at Fairchance it is but little better. The following analyses give a fair illustration of the character of the ore:

I. J. F. Stairs, Mt. Pleasant township, Westmoreland county. (D. McCreath.)

II. Lemont Furnace, North Union township, Fayette county. (D. McCreath.)

III. — Simmons, South Union township. (McCreath.)

IV. Fairchance Furnace, Georges township. (Chandler.)

V. Springhill Furnace, Springhill township. (Chandler.)

	I.	II.	III.	IV.	V.
Iron,	32.200	18.000	11.100	3.49	5.04
Sulphur,	0.040	0.026	0.313		
Phosphorus,	0.123	0.261	0.018	0.12	0.19
Insoluble residue,	24.160	18.190	26.090	52.35	21.25

In West Virginia, a lean ore is commonly found in the shales immediately above the Mahoning Sandstone. On Deckers and Booths creeks, it was digged extensively for use at the old furnaces, which were in blast there many years ago. This, no doubt, is the Haines Ore, to which Prof. Rogers makes reference in his report on the Pridevale property. It seems to be persistent in West Virginia to a considerable distance south from the Baltimore and Ohio railroad.

3. THE FREEPORT GROUP.

This group of ores seems to be confined almost wholly to Fayette county, and the adjoining portion of West Virginia. Its members are of uncertain occurrence, and in this district their importance is purely local, though in West Virginia

they are persistent over a large area. An irregular bed of ore sometimes appears directly under the Mahoning Sandstone, and at Springhill it has been mined. But northward from that locality it disappears. A similarly variable bed was seen in this position on Deckers creek, in West Virginia, only a few miles south from the State line.

The Freeport Limestone is always more or less ferruginous. On Jacobs creek, in Mt. Pleasant township, of Westmoreland county, it has been mistaken for iron ore, but on the same creek, in Tyrone township, of Fayette county, it has on top a layer from 16 to 20 inches thick, which is a very fair calcareous ore. On Dunbar creek, it is all 10 inches thick, and appears to be a calcareous ore of good quality. At Springhill furnace, it contains a ferruginous layer, somewhat more than one foot thick, which, on the out-crop, is a strong calcareous ore, but, followed under the hill, soon changes into a limestone. The variation here is shown in the following analyses by Chandler, the first from the out-crop, and the second from a few feet under cover:

Iron,	31.23	4.21
Phosphorus,	1.04	0.01
Insoluble residue,	16.92	3.85

The character of the ore on Jacobs creek, where it is known as the "Coal Bank Ore," is shown by analysis to be (McCreath):

Iron,	26.500
Sulphur, . . . . .	.090
Phosphorus, . . . . .	.046
Insoluble residue,	13.810
Carbonate of Lime,	23.120

Prof. Rogers states that an ore bed exists at this horizon, on the Pridevale property, and refers to the occurrence of ore in a similar position on Deckers creek. At the latter locality, the Freeport Limestone is absent, but almost directly under the *Upper Freeport coal bed* there is an ore of great excellence, which was used at the old furnaces, on both Deckers and Booths creeks. I have not been able to trace this ore beyond the southern line of Monongalia county, in West Virginia.

Aside from insignificant streaks, no other ores belonging

to this group were seen in any portion of the district, except in Springhill township, of Fayette, and on Jacobs creek, at nearly three miles above its mouth. In Springhill township a bed of ore is associated with the limestone, which I have regarded as probably the equivalent of the Ferriferous Limestone. It was once mined to a limited extent here, but does not seem to be looked on as valuable. In West Virginia this ore is found at many places in the northern part of the State, and is intimately associated with the Ferriferous Limestone. On Deckers and Booths creek, in Monongalia county, as well as at various places in Preston county, it was used as an ore, and was thought to be very useful, as it was both ore and flux, owing to the large proportion of limestone which it contained. Like all the ores of the group, it becomes lean in West Virginia, as may be seen from the analyses given in the fourth and fifth annual reports of Prof. W. B. Rogers, on the geology of Virginia.

Two ore beds belonging to this group and below the Freeport limestone, were once worked on Jacobs creek to supply the old furnace. They are known as the Furnace and Forge veins, the former being the upper. Their composition is as follows (McCreath):

Iron,	40.750	28.300
Sulphur,	0.278	0.079
Phosphorus,	0.229	0.137
Insoluble residue,	5.120	13.885

4. THE MOUNT SAVAGE (?) ORES.

Respecting this group the information is quite limited and inexact, as most of the openings or benchings were abandoned many years ago. In Fayette county, it contains two and at some localities three beds, one above the *Mount Savage (?) coal* another below it, and where the coal is in widely separated divisions, a third between the parts of the coal bed. How persistent these individual beds may be is not known; but it is sufficiently clear that at this horizon there is always more or less of iron ore in Fayette county and the adjoining portion of West Virginia.

In Westmoreland county no ore was seen belonging to this group, but in Bullskin township, of Fayette, near the Old Vernon mines, a bed of ore, from 4 to 6 inches thick, rests on the Pottsville or Seral Conglomerate. It lies under thin cover for a long distance up the mountain side, as the Conglomerate is near the surface. Formerly this bed was extensively benched, but the work has been discontinued and the supplies for Charlotte furnace are obtained from the Umbral group. In Dunbar township, some ore occurs at this horizon, but it has not been tested. In North Union township, a layer belonging to this group was once mined very largely on Smiley's and Jude's hills to supply the old Cool Spring furnace, which stood on Shutes run. Here it was known as the "Jude ore," and varied from 4 to 10 inches in thickness. Its exact relations to the coal and Conglomerate cannot be determined now by direct examination, as the workings were abandoned long ago, and the material thrown out during the benching has so covered everything, that no calculation for interval can be made. Among the old diggers the impression prevails that it was over the coal. Near Ritenour's mill, on Shutes run, an ore bed has been opened up at about 10 or 12 feet above the *Mount Savage (?) coal* but at the time of examination the digging was not large enough to show the thickness accurately. The lower bed has been opened in South Union township, on Redstone creek, near the mouth of Jobs Hollow, where it is a compact layer, 4 inches thick, and is known as the Mahan Ore. The middle layer is unknown in the northern part of the county.

At Springhill, the upper layer is about 10 feet above the coal, and yields good ore. Here the *coal bed* is in two widely separated benches, between which is a layer of good ore.

In West Virginia, north from Cheat river, this group shows several thin layers, all of them lean. They are distributed through a greater thickness of rock, and seem to lie altogether above the coal. Throughout this region they are known as the Stratford Ores, and the coal as the *Stratford Coal*. On Deckers creek the conditions are the same as on Cheat, and the layers of ore are above the coal, dispersed through nearly fifty feet of shale. Further south there

appears to be but one bed, for at Nuzum's mills, on the Baltimore and Ohio railroad, the section is distinct and only one can be seen. This underlies the coal or rather occupies the same level, being found only where it has displaced the coal. It is of excellent quality, but occurs in nodules enclosed in a hard non-plastic fireclay, similar to that occurring at Mount Savage, in Maryland. Beyond this southward no ore was found representing the Mount Savage group.

5. THE UMBRAL ORES.

These ores are an important source of supply for the furnaces now working along the foot of Chestnut ridge. Northward, they disappear not far from the middle of Mt. Pleasant township of Westmoreland, and they are not to be seen on the Loyalhanna or the Conemaugh. Southward, they extend beyond the Cheat river, in West Virginia, but the distance beyond that river cannot be great, for they do not seem to have been found in Preston county, along the line of the Baltimore and Ohio railroad. The section of the group is extremely variable, but approximately is as follows:

1. Pottsville (Seral) Conglomerate,	—
2. Interval,	0' to 20'
3. Little Honeycomb ore,	0' 5"
4. Interval,	0' to 20'
5. Big Honeycomb ore,	1' to 0"
6. Interval,	0' to 15'
7. Kidney ore,	0' 2" to 10"
8. Interval,	2' to 17'
9. Big Bottom ore,	1' to 3'
10. Interval,	14'
11. Red Belt ore,	0' 10"

In the southern portion of the district the whole interval between the Conglomerate and the Big Bottom Ore is but 27 feet; on Shutes run, near the old Coolspring furnace, it is nearly 80 feet; at Lemont mines, 70 feet; at Dunbar mines, 94 feet; at the Vernon mines, in Bullskin township, 3 feet; while on Jacobs creek it varies from 36 feet to 80 feet. At the Vernon mines the upper portion of the section has disappeared, and the Conglomerate rests directly

on a little bed of ore, which I have regarded as probably representing the Kidney. All of these ores have been mined within the district, and some of them have been in use for more than seventy years.

The *Little Honeycomb Ore* is usually about 4 inches thick, and forms a compact continuous layer. On Jacobs creek it is present at one locality, but nothing is known respecting its thickness. A rude opening was made many years ago, but the ore was too thin to be worked to profit. On Mount's creek, at the Vernon mines, this ore is wanting. No attempt has been made to mine it on the Youghiogheny or at Dunbar, but further south, in North Union township, it was mined by benching on Jude's and Smiley's hills for Coolspring furnace. The quality was so good that the owner of that furnace benched for the ore even when the cover was 20 feet thick. At Springhill, it is only 6 feet below the Conglomerate, and, being readily accessible, it was mined extensively by benching. Everywhere this ore is very pure, but unfortunately is too thin to be mined by drifting.

The *Big Honeycomb ore* is one of the finest in the whole series. In Springhill and Georges townships it is a compact flag, from 10 to 12 inches thick, and comes out in fine blocks. It is dark-gray to brown, very fine grained, and somewhat micaceous. In quality it is thought to be but little inferior to the Blue Lump of the Pittsburg group. This ore was obtained for Springhill and Fairchance furnaces by benching, and no systematic mining was attempted. In South Union, near the head of Redstone creek, it was once mined by benching, but the diggings are filled up, and no information can be obtained respecting it. On the National road it is concealed.

At the Lemont mines in North Union township, the ore occurs in three layers, thus:

Ore, . . . . .	.0' 1" to 2'
Shale, . . . . .	.0' 10"
Spongy ore, . . . . .	.0' 4" to 6"
Shale, . . . . .	.1' to 2'
Compact ore, . . . . .	.0' 4" to 6"

In general appearance and quality this does not differ

from the ore at Springhill. Fortunately for mining, there is a small coal bed below the ore which affords an excellent bearing-in and lessens the cost of extraction. At the time of examination, the entry on this bed was barely 200 feet long, but so far, no irregularity had been found, and the ore seemed to be perfectly constant.

At the Dunbar mines, the ore is very different in appearance and general character. It has a honeycomb structure, such as marks the ordinary kidney or lump ores of the coal measures. But unlike those, it is a plate. In all openings further south, as far as followed, it is regular, but here it exhibits variations in thickness, which, in one mine, are so excessive that under ordinary circumstances the ore would be worthless, owing to cost of mining. But the presence of the little coal below affords such advantage to the miner, that even in the poorest mine belonging to the company men can be employed to dig this ore at the same rate which is paid for digging the more regular Big Bottom. The extreme thickness here is one foot. The Big Honeycomb ore is said to occur on the Youghiogeny, at the sand-works above Connelville, but the mines there had been abandoned before my visit to the place, so that no examination of the ore could be made.

At the Vernon mines this ore is wanting. On Jacobs creek, above Laurelville, it is present, but the opening was deserted many years ago, and the ore cannot be seen. At the saw-mill, two or three miles further up the creek, both of the Honeycombs are wanting.

The character of the ore from this bed is shown by the following analyses, of which the first is that of a specimen from Springhill, the second from Lemont (D. McCreath), and the third from Dunbar :

Iron,	39.77	41.400	35.823
Sulphur, . . . . .		.184	
Phosphorus,	0.22	.151	0.030
Insoluble residue,	12.98	6.430	15.568

The *Kidney ore* is present on Jacobs creek, at the upper exposure near the saw-mill, but lower down near Laurelville it is concealed, if present. Here it shows the peculiar

structure which was observed at several localities in the southern part of the district. The plate is pierced at irregular intervals by vertical borings which anastomose. These are filled with red shale, like that in which the ore occurs. At the Vernon mines this bed is represented probably by the *pin ore*, which is directly under the Conglomerate, and two or three feet above the Big Bottom. There the ore is nodular, not a flag as on Jacobs creek. On the Youghiogheny, the ore is no longer exposed at the mines above Connellsville, but at that locality the character is said to be the same as at the Dunbar mines, where it is a plate. The vertical borings are wanting here, and the structure is more nearly like that of the ordinary kidney ores found in the Coal Measures. The thickness of the Kidney at these mines is quite as variable as that of the Big Honeycomb, and the workings are by no means satisfactory. But the quality of the ore is so good that it is usually followed up to secure whatever can be got.

At the Lemont mines, the ore presents the appearance already seen on Jacobs creek. Here it is a compact plate from 4 to 8 inches thick, but averaging about five inches. It is mined by drifting, as a thin coal below it affords a convenient bearing-in. The entry, at the time of examination, had been driven in about 200 feet, and the ore had shown no irregularity or signs of diminution. It seems to be regular throughout, and notwithstanding its thinness, can be mined as cheaply as some of the thicker members of the group. On the National road the ore is nodular. On the Springhill and Fairchance properties the character is the same as at the Lemont mines.

At all localities this bed yields excellent ore, though somewhat cold-short, as appears from the results of numerous analyses.

I. Lemont mines, North Union township, Fayette county. (D. McCreath.)

II. Vernon mines, Bullskin township. (McC.)

III. Jacobs creek, Mount Pleasant township, Westmoreland county. (D. McC.)

	I.	II.	III.
Iron,	38.800	41.000	31.100
Sulphur, . . . . .	.408	0.191	0.086
Phosphorus, . . . . .	.195	0.120	0.103
Insoluble residue,	10.605	6.810	25.960

At Dunbar there is sometimes found between the Kidney and the Big Bottom another bed known as the "Flag ore," which is of little importance there, and does not occur at any other locality. It is a fair material at the outcrop, but I was informed by Mr. McClavy, the superintendent of the Dunbar mines, that at a short distance under the hill it becomes only a ferruginous sandstone.

The *Big Bottom ore* is persistent at all localities examined by me, and, in some respects is the most important of the group. It is ordinarily a flag, in two or more layers, dark brown to grayish or bluish brown in color, and almost fine enough in grain to be used for hones. Rarely it contains specks of what seems to be zinc blende and sometimes it shows handsome drusy carbonate of iron. Occasionally nodules of pyrites occur, but they are of minute size, and are insufficient to affect the character of the ore. As will be seen, this bed, though persistent, is so troubled with horsebacks that one on a hasty examination would be compelled to pronounce it economically worthless; but on careful examination this conclusion would be changed, for these "wants," as they are termed, though sometimes very extensive, serve merely to impair the value of the deposit, and do not suffice to render it in any degree unimportant.

This bed is well exposed on Jacobs creek, both at the openings near Laurelville and at the saw-mill further up the stream, as well as near the head of the creek. At each of these localities it has been opened. Near the head of the stream it shows 3 feet of ore in one layer, but this thickness is excessive, and shows that the ore is soon to disappear, it being characteristic of this bed to thicken up in this way near a horseback. Above Laurelville it shows in all 12 inches of ore, in two layers, separated by two inches of clay. At the Vernon mines it is in two layers,

separated by three inches of clay. The quality is excellent, but horsebacks cause serious annoyance.

At one time this bed was mined on the Youghiogheny river above Connellsville, but the mines have been deserted, and no information can be obtained now. At the Dunbar mines, it is usually found in three layers, though occasionally it breaks up into four, and sometimes there are but two. On this property the workings are very extensive, and go far toward proving the persistence and great value of the deposit, mine No. 1 being 2,500 feet, and mine No. 5, 2100 feet long. As at all other localities the ore is sadly troubled by horsebacks, which sometimes cut out the whole for a distance of eight or ten yards. Near these the ore thickens greatly, and in some cases becomes 2 feet 6 inches. As a rule, the quality is very good, though the percentage of iron is apt to vary as much as three per cent. in adjoining openings. The most perplexing variation is one which causes a complete change in character. For the most part the ore is an exceptionally good carbonate, carrying but a low fraction of phosphorus, but every entry, thus far opened, has crossed a wretched siliceous ore holding much manganese and more than one per cent. of phosphorus, with a reduced proportion of iron. This peculiarity is confined to this locality, and was seen nowhere else. Fortunately, the band of poor ore is narrow, and easily distinguished from the other. It is in a single layer.

On the Lemont property the Big Bottom has been opened on both parts of Smiley's hill, and some very old openings were seen on Shutes run, which had been worked for the old Coolspring furnace. At the latter locality, the ore has a dull gray color and is slaty in appearance, but is excellent, and is sometimes mined here for use at the furnace. On the north division of Smiley's hill, an opening which had barely passed the outcrop showed three layers, 9, 3, and 5 inches thick, with an irregular layer of nodular ore at the base. On the southern division of the hill there are two layers at seventy feet below the Conglomerate. In a trial opening made on the east side of the hill, the ore was seen, in a single layer, nearly 3 feet thick, but this, no

doubt, was owing to the proximity of a horseback. In this neighborhood the entries have been driven only a short distance, but the ore has had ample opportunity to exhibit its capacity for variation, and already much annoyance has been caused by its occasional total disappearance.

Near the National road the Big Bottom ore has been mined for shipment to Lemont and Dunbar furnaces. It is found in two compact layers, and shows a total average thickness of somewhat more than 14 inches. The only noteworthy feature here is that, though the entries have been driven a long distance, yet the ore has not wholly disappeared at any time. In quality it resembles the ore at Lemont and Dunbar, and selected specimens are said to have shown forty-one per cent. of iron.

No openings in this ore were found in South Union township, but in Georges and Springhill it has been mined for use at Fairchance and Springhill furnaces. As these furnaces have lain idle for several years, the workings have fallen into decay and the beds are no longer accessible for examination. But the character is the same as at localities already referred to. The ore is usually double, though sometimes triple, and the average thickness is not far from 18 inches. The deposit is comparatively uncertain and frequently disappears for several yards.

The character of the ore may be seen by examination of the analyses here given.

I. Springhill township, Fayette county. (Chandler.)

II. Georges township. (Chandler.)

III. Lemont, North Union township. (D. McCreath.)

IV. Dunbar township.

V. Bullskin township. (McCreath.)

VI. Jacobs creek, Westmoreland county. (A. S. McCreath.)

	I.	II.	III.	IV.	V.	VI.
Iron,	32.010	37.440	36.200	35.664	31.200	1.412
Sulphur,			0.107	trace.	0.253	0.035
Phosphorus,	trace.	0.250	0.154	0.008	0.129	0.240
Insoluble residue, . .	22.150	12.000	12.980	16.700	21.980	39.275

The Red Belt ore was not seen at any of the northern localities, and seems to be confined to the southern portion of the district. In Springhill township it is about 10 inches thick and is said to yield a good ore, which has been mined to a slight extent for use at Springhill furnace. It is distinctly marked by a band of shale, deeply stained by oxide of iron.

In West Virginia, north from Cheat river, these ores all occur, but they evidently disappear or at least become of little value at a little way further south. They have not been traced beyond Booths creek, and are clearly absent at some localities further south along the continuation of Chestnut ridge. In the report on the Pridevale property, Prof. W. B. Rogers describes five beds of ore belonging to this group, but of these only four have been identified by me in Pennsylvania. The fifth is a hematite lying near the Umbral limestone. It was reported as existing in Springhill, Georges and Dunbar townships, of Fayette county, but it is concealed at all localities examined by me.

PART III.
GEOLOGY BY TOWNSHIPS.

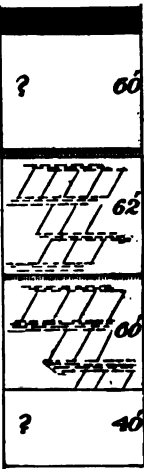
CHAPTER XI.
FAYETTE COUNTY.

1. *Springhill Township, of Fayette County.*

This township lies along the Monongahela river and adjoins Monongalia county of West Virginia. The exposed section extends from the *Sewickley* coal bed to the *Vespertine* rocks, the latter being exposed in the deeper ravines and along the crest of Laurel (Chestnut) hill. The Upper Productive Coal Series are confined to the highlands in the central portion of the township, having been cut away elsewhere by the tributaries to Georges creek, at the north, and by those to Cheat river, at the south, as well as by those to the Monongahela at the west. Along the three streams mentioned, the rocks of the Lower Barren Series are continually exposed. The Saltsburg anticlinal enters the township near Crow's mill, on Georges creek, and crosses Cheat river just above its mouth. The Blairsville synclinal is crossed, near Grassy run, by the road leading from Morris cross-roads to Springhill furnace, and enters West Virginia very near the Line ferry on Cheat river.

Along the Morgantown road, the following section is seen in ascending from Georges creek :

Fig. 12.

1. <i>Pittsburg coal bed</i> ,		18'
2. Concealed,	?	60'
3. <i>Coal bed</i> ,		1' 6''
4. <i>Limestone</i> ,		2'
5. <i>Shale and sandstone</i> ,		62'
6. <i>Coal bed</i> ,		Blossom.
7. <i>Limestone</i> ,		Fragments.
8. <i>Shale and sandstone</i> ,		60'
9. Conc'd to the creek,	?	40'

Georges Creek.

The *Pittsburg coal bed* is mined alongside of the road by Mr. Sturgiss, at a little more than a mile south from Georges creek, and shows:

Roof division,	4'	} 13'
Main clay parting,	6" to 8"	
Lower division,	8' 6"	

The roof division consists of two layers of *coal*, 2 feet and 1 foot respectively, separated by 1 foot of dark laminated shale. The lower division is broken by ten clay partings from one half inch to one inch thick, all of which carry pyrites. The coal itself seems to contain very little of that impurity and ought to make a clean coke. Underlying the bed is a fireclay, three feet thick, below which iron ore seems to be present in considerable quantity. From this point southward the road lies below the coal until within less than half a mile of Morris Cross-Roads, where several banks were seen, which do not differ in any material respect from that just referred to. At the Cross-Roads, the *Red-stone coal bed* was found in an excavation near the hotel, and is 18 inches thick. From the Cross-Roads to the hill directly facing Cheat river, the road is far above the *Pittsburg*. The *Sewickley* was seen at two places, and barely 15 inches thick, evidently a local degradation, due to erosion

when the bed was still uncovered, for at a short distance both east and west the coal is several feet thick. On the Brooks farm, about three fourths of a mile from Cheat river, the *Pittsburg coal bed* is exposed at 265 feet above the stream. The section is unusual:

1. Sandstone,	15'
2. Coal,	0' 2"
3. Sandstone,	3'
4. Coal and clay,	1'
5. Clay and coal,	1' 6"
6. Coal,	6"
7. Main clay parting,	0' 2"
8. Lower division,	8' 4"

The sandstone No. 3 is very hard, contains fragments of coal, and shows a tendency to become nodular. As the roof has fallen, no examination can be made inside the entry, but the thin layer of coal, No. 2, and the rude fragments of coal in No. 3, lead to the supposition that the condition is due to a crush, and is of limited extent. The lower division is apparently good coal, but is seriously broken by thin layers of clay which are chiefly "binders" rather than partings.

At about a mile from Cheat river, on the road from Point Marion to New Geneva, the *Pittsburg coal bed* is seen at 380 feet above the river, barely 100 feet higher than at the Brooks bank, nearly three miles south-west, so that the dip is not more than 35 feet per mile. Here the bed is mined by Mr. Burchinal, but the openings were in such condition, when visited, that no examination could be made. According to Mr. Burchinal, the bed shows a serious variation in these openings, which are but a few rods apart. In the first, the coal is only six feet thick and is roofed by clay, above which comes the sandstone. No information could be obtained respecting the thickness of the clay.

In the other opening the bed is 11 feet thick and all the partings are so thin, that Mr. Burchinal regards the mass as one. A similar condition exists in a bank near the West Virginia line in the neck between the Cheat and Monongahela rivers. There the full thickness is 11 feet, with somewhat less than 2 feet of coal in the roof, but the partings are

so thin that one finds difficulty in distinguishing the two divisions. The total amount of coal at these banks is little more than is commonly found in the southern part of the Blairsville trough.

Just before reaching the cross-roads at Mr. Burchinal's residence, the *Redstone Coal bed* is seen at the roadside. It is a thin bituminous shale and its limestone is absent. The *Sewickley coal bed* is exposed in the road a short distance further on, with the Fishpot Limestone at a couple of feet under it. No openings were found in this coal, though it is fully five feet thick. From this exposure to New Geneva there are no openings in the *Pittsburg*; and, for a large part of the distance, that bed has been removed by erosion to afford room for the 270-feet terrace, of which the detrital mass yields a fine clay and an equally fine glass-sand, which will be referred to in another connection.

Between this road and the river, the *Pittsburg coal bed* has been opened on the properties of Mr. Hertig, Mrs. Oliphant and Dr. Thompson. The roof shows some variation in structure, but the lower division is quite constant. The coal is of excellent quality, though somewhat broken up by thin binders and partings of compact clay.

On the road leading from Crow's Ferry to Springhill furnace the *Pittsburg coal bed* is available from half a mile east from Mr. Burchinal's cross-roads to fully a mile and a half east from Morris cross-roads. West from the latter place openings are numerous on both sides of the road, all of which show practically the same section, differing little from the following, which was obtained about one third of a mile west from the cross-roads:

1. Shale,	20'
2. Blue Clay,	0' 6"
3. <i>Pittsburg coal bed</i> ,	
Roof division,	2'
Main clay,	0' 2"
Lower division,	8'
	} 10' 2"

The roof division contains 8 inches of coal in two equal layers and 10 inches of clay and coal in one layer. The total of coal is not more than 13 inches. Half a mile west from the cross-roads, the ores of the *Pittsburg group* were

formerly mined by benching for reduction at the Springhill furnace. Mr. John Oliphant, who was in charge of the furnace, states that the Blue Lump ore from this vicinity is equal to any procured along the east side of the trough.

At the cross-roads the *Redstone coal* is 50 feet above the *Pittsburg*, and one eighth of a mile east from that place the *Sewickley* is well exposed in the roadside with a thickness of about four feet. Descending the hill toward Grassy run, the *Pittsburg coal bed* is soon seen, and at little more than a mile from the cross-roads, its outcrop is passed, the bed still dipping east. In this township, therefore, the *Pittsburg bed* has been swept away from the eastern side of the trough. At two miles north from this road, the coal barely crosses the axis of the synclinal. Beyond its outcrop, eastward, there are no exposures until the Uniontown and Ice's Ferry road is reached.

From the line of Georges township to within sight of Springhill furnace this road passes through the lower barren rocks. At barely half a mile from the furnace a small coal bed is seen at the roadside, and at a little distance further south the Green Fossiliferous limestone is imperfectly exposed near the road. Seventy-five feet below this limestone is a coal bed 3 feet 3 inches thick, which is mined at the forks of the road near the furnace, and has been mined by stripping at several other places in the vicinity. It is said to be a good coal for use in grates as it burns freely and contains little sulphur; but the ash, though powdery, is so bulky that the fuel cannot be used advantageously in close stoves.

Sixty feet below this bed is another, not seen by me, which is said by Mr. J. T. Hickle to be 3 feet thick and roofed by 3 feet of richly carbonaceous shale. At one time this bed was exposed by Mr. Hickle while he was ore superintendent for the furnace. At an opening near the State line the thickness is somewhat less. Overlying it is a sandstone, which forms a bluff, 30 feet high, alongside of the furnace. At a little distance further up Rubblers run, there is a limestone, probably 10 feet thick, which is quite ferruginous in its upper portion and has so promising ap-

pearance that it is locally regarded as valuable, and is known as the Hardman Ore. It occupies the position of the important ore at Johnstown, Pennsylvania. Analyses, however, do not show that it is of any value, as it is only an impure limestone, with from three to five per cent. of metallic iron. The interval between it and the coal just referred to is but a few feet.

Sixty feet below this limestone is the *Upper Freeport coal bed*, the measurement being made directly on the hill on the south side of the run. The intervening rocks are not exposed in detail, but there is evidently a thick sandstone beginning about 15 feet above the coal and occupying a large portion of the interval. The coal itself was first seen at the junction of Wymp's gap and Drague runs, where the old Jones bank gives the following exposure :

1. Sandstone,	—	
2. Shale,	15'	
3. <i>Upper Freeport coal bed</i> ,		
1. Coal,	0' 1"	} 16' 3"
2. Clay shale,	3' 0"	
3. Slaty coal,	0' 2"	
4. Clay,	1' 6"	
5. <i>Coaly shale</i> ,	0' 4"	
6. Clay,	1' 0"	
7. Carbonaceous shale,	0' 5"	
8. Clay,	0' 3"	
9. Coal,	1' 8"	
10. Dark clay,	0' 10"	
11. Prismatic coal,	2' 0"	
12. Hard clay,	1' 6"	
13. Coal,	3' 6"	
4. Fire clay,	6'	
5. Freeport limestone,	4'	

The coal above the hard clay, No. 12, is not good and is used only for burning lime and similar coarse work ; but the lower division, No. 13, is of excellent quality and is said to make a coke, which is thought to be but little inferior to that made from the *Pittsburg coal*. The underlying clay, it is said, has been employed in the manufacture of pots for glass-making. At some openings here, according to Mr. Hickie, it is compact ; but this character is found only in very limited areas and the clay suddenly changes to the plastic variety. The Freeport Limestone is somewhat

ferruginous on top and very markedly so at the bottom. Along the outcrop on Drague hollow the whole bed is in great measure replaced by a handsome calcareous ore, which was tested at Springhill furnace with such satisfactory results that it was extensively benched on the outcrop along Drague hollow and on the high terrace south from the run. At a few feet below the limestone is a flaggy sandstone, which was used for furnace lining at Springhill.

Thirty-two feet below the *Upper Freeport coal bed* is the *Lower Freeport*, which has been opened at the Kirk bank, where it shows:

1. Drab shale, seen,	4'
2. <i>Lower Freeport coal bed</i> ,	
1. Coal,	2' 8"
2. Clay,	0' 1"
3. Coal,	0' 3"
4. Clay,	0' 3"
5. Coal,	0' 11"
3. Fire clay,	2'
4. Iron ore,	2' 6"

The top bench is quite sulphurous, there being a good deal of pyrites in thin streaks, and the bottom contains much clay. The coal burns nicely enough, but is soft, and leaves a rather bulky ash, so that it is not very highly esteemed. The fire clay is not bad, but is inferior to that underlying the *Upper Freeport*. The ore, No. 4, is locally known as the *Johnstown*, and varies from one foot to the thickness given in the section. It was mined for the furnace, and proved to contain about 25 per cent. of metallic iron.

Thirty-one feet below the *Lower Freeport* is another coal, which may be the equivalent of the *Kittanning*. Its place was pointed out to me on Drague run, where it was once opened, and its fragments now lie scattered on the old dump. It is said to be from 3 to 4 feet thick, but nothing can be ascertained respecting its quality, as it was opened not for use, but incidentally, in a drift run to obtain a ferruginous limestone underlying it. This limestone is no longer exposed, but its character is easily determined from the fragments, which lie scattered in large quantity near the mouth of the old drift. It is from 2 to 3 feet thick, and contains so much iron as to be a calcareous ore. As such, it was

mined for use at the furnace. This is probably the Ferriferous Limestone. A thin band of ore is said to occur at 5 feet below it.

Below this stratum, no further exposures occur along Drague hollow, and the remainder of the section was obtained on the terraced hill projecting from the mountain, at the south side of the hollow. At 15 or 20 feet below the *Kittanning* (?) coal bed there is a remarkably fine fire clay, compact, and from 4 to 6 feet thick, which has been opened at several places along the face of the ridge. It is drab to dove-colored, being persistent, and always compact, like that at Mt. Savage, or in the Tuscarawas valley. After long exposure, it breaks in small angular fragments, but never becomes plastic. It has been used in the manufacture of fire brick here, and has been shipped for that purpose from an adjoining property. For the most part, it is free from iron, but occasionally a nest of ore is found, which, for a short distance, wholly displaces the clay. Directly under the clay is a coal bed, 1 foot 8 inches thick. Over it is a flaggy sandstone, 3 feet, and the remaining interval to the Ferriferous (?) Limestone seems to be filled with reddish, somewhat fissile shale.

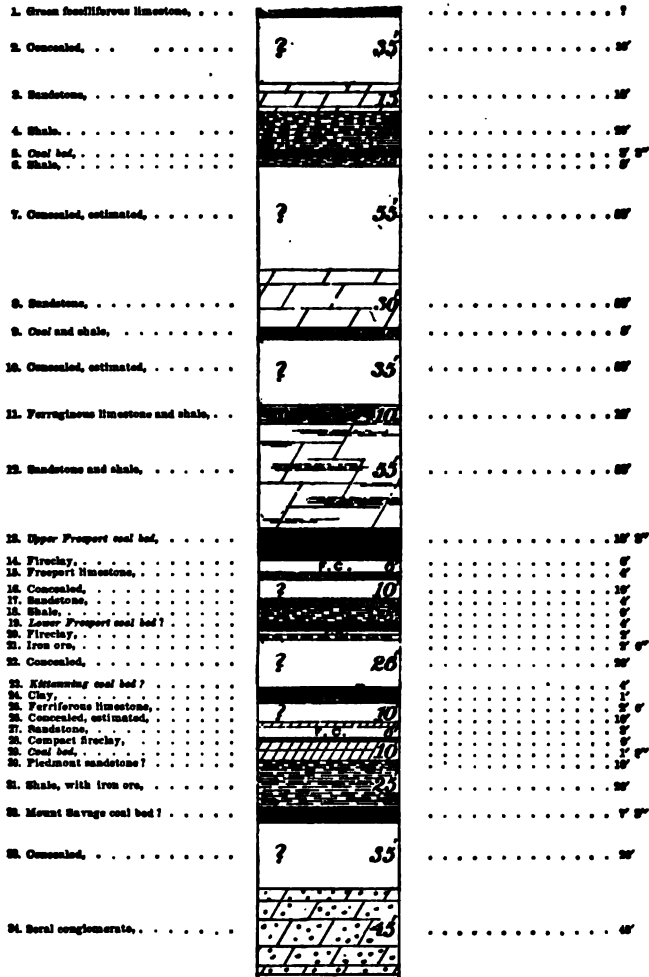
Below this is the massive Piedmont (?) Sandstone, about 10 feet thick, resting on argillaceous shale, which contains the ores of the Stratford or Mt. Savage (?) Group. In this shale, which is about 25 feet thick, the ore occurs in irregular layers, of which the largest is 8 inches thick. All of these were formerly stripped for use at the furnace, but at present no one of them is exposed.

The *Mt. Savage* (?) coal, known locally as the *Stratford coal*, was at one time fully exposed during explorations for the ore known, near Cheat river, as the Carr ore; but like nearly all openings, both of coal and ore, on the great Fairchance estate, it has been abandoned for several years, and everything is concealed. According to Mr. Hickle, the section of the coal bed is as follows :

Coal,	2' 6"	} 7' 3"
Clay,	3' 0"	
Ore,	0' 6"	
Coal,	1' 8"	

The coal was never used for any purpose, but the ore is said to be quite good, though like all the ores of this group it is rather lean. The interval between this coal and the Conglomerate below, as measured along the strike, is 35 feet, in which everything is concealed. The following is the general section, obtained in the vicinity of Springhill furnace:

Fig. 18.



Near Springhill Furnace.

The Umbral ores were formerly mined at the head of Drague hollow to supply Springhill furnace, but as that furnace used only charcoal and had but a weak blast it was unable to reduce any except crop ores, so that the only mining was by benching and no ore was followed to any distance under cover. These crop ores are all rich and easily reduced. To bring the solid ore to a similar condition it was necessary to expose it to the atmosphere for a year and then to subject it to thorough roasting, after which no difficulty was found in the attempt to reduce it. The whole series of these ores is present here and most of the beds show an average thickness rather greater than is found in the townships further north. There is also a marked difference in the intervals, which here are very much diminished, so that the ores can be obtained at much less cost than at localities north from the National Road. The succession on the Fairchance property is as follows:

1. Pottsville (Seral) conglomerate,	45'
2. Coal,	1' 2"
3. Clay shale,	5'
4. Little Honeycomb ore,	8" to 4"
5. Clay shale,	12'
6. Big Honeycomb ore,	1'
7. Clay shale,	1' to 8"
8. Coal,	1' 3"
9. Clay shale,	2'
10. Kidney ore,	8"
11. Clay shale,	3'
12. Big Bottom ore,	1' to 2'
13. Clay and sandy shale,	14'
14. Red belt ore,	10"

The Big Bottom ore occasionally spits up into three layers, each of which has a maximum thickness of one foot. The Big Honeycomb is a splendid ore and comes out in great blocks. The ores are all regular except the Big Bottom, which varies much in thickness and at times wholly disappears.

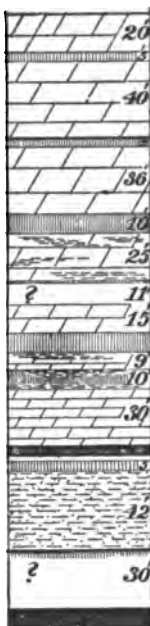
Southward from Springhill furnace there are no exposures to the State Line. Beyond that to Ice's Ferry there are several openings in the *Upper Freeport coal bed*, which show great variations, the thickness of the bed being from two to six feet.

2. GEORGES TOWNSHIP OF FAYETTE COUNTY.

This lies north from Springhill, along the face of Laurel (Chestnut) hill, and the exposed section extends from the *Waynesburg coal bed* to the Vespertine rocks. The strata of the Upper Productive Coal Series are confined to the north-western half of the township, and the *Pittsburg coal bed* has a very sinuous outcrop at the south-east. The course of the Blairsville synclinal was not determined satisfactorily, but the line seems to be faulted almost midway in the township. In the southern portion it passes somewhat more than a mile east from Smithfield, but at the north it was found near the head of York's run, considerably west of the course from Cheat river to the point east from Smithfield. Good exposures are occasionally obtained in the Upper Series, but in both the Lower Barren and Lower Coals the exposures are far from being satisfactory.

Along the Morgantown road, which follows a direction but little off the strike, the *Waynesburg Coal* is not reached, but it is caught in a few hills rising fifty or sixty feet above the road, near the northern line of the township. The Waynesburg Limestone is shown in the road at half a mile south from that line, and the *Uniontown coal bed* is seen at the first fork north from the Presbyterian church. The limestone under it is only four feet thick. The following section was obtained between the township line and Smithfield :

Fig. 14.

1. Sandstone,		20'
2. Waynesb'g limest'e,		5'
3. Sandstone,		40'
4. <i>Uniontown coal bed</i> ,		—
5. Limestone,		4'
6. Sandstone,		38'
7. Limestone,		10'
8. Sandstone and shale,		25'
9. Limestone,		1' 3"
10. Concealed,		11'
11. Sandstone,		15'
12. Limestone,		10'
13. Sandstone and shale,		9'
14. Limestone and shale		10'
15. Laminated sandst'e,		30'
16. <i>Sewickley coal bed</i> ,		5'
17. Clay,		3'
18. Fishpot limestone, .		5'
19. Sandy shale,		42'
20. <i>Redstone coal bed</i> ,		Blossom.
21. Limestone, Redstone		Fragments.
22. Concealed,		30'
23. <i>Pittsburg coal bed</i> ,		12'

Upper Coal Series.

The limestones between the *Uniontown* and *Sewickley coal beds* are well exposed in the road for a distance of one-fourth of a mile north, and half a mile south from the Presbyterian church. Just beyond that church and a little way east from the road, Mr. Stewart and Mrs. Robinson mine the *Sewickley coal bed* for domestic use. At their openings it shows two benches 49 and 19 inches thick, separated by half an inch of clay. Binders of clay are numerous. The coal is a good fuel but burns away rapidly, leaves a bulky ash, and is said to contain a considerable percentage of sulphur. It shows few horsebacks and these are of insignificant extent. This bed is not reached along the road until within two miles and a half of Smithfield. There the Fishpot Limestone is seen barely five feet thick and very ferruginous. Somewhat more than a mile further south the *Redstone coal bed* is seen, apparently resting on the Redstone Limestone which is imperfectly exposed, and is evi-

dently very thin. The *Pittsburg* is first reached about a mile north from Smithfield, and thence, almost to that village, the outcrop of the bed is west from the road, which lies in the Lower Barrens, and exposes thin *coal beds* at 20 feet, and 60 feet below the *Pittsburg*, the lower one resting on a thin limestone.

Smithfield is situated on a high hill, rising probably seventy feet above the *Pittsburg coal bed*, and shaped like the longitudinal section of a pear. The village is at the broader extremity, and the apex is at the corner of the township where the road passes out into Nicholson. The area of coal is wholly west from the Morgantown road, south from Smithfield, though at one point the coal touches that road, and is opened. The last bank belongs to Mrs. Sutton. These openings do not differ from those to be described hereafter, but the *Pittsburg Sandstone* is well shown as a coarse rock 25 feet thick.

Along the road from Uniontown to Fleatown, in the north-western corner of the township, the *Pittsburg coal bed* is mined by Mr. Dawson, and at Fleatown, near the store. These openings are all unsatisfactory, as they do not show the roof, and the lower division is only partially exposed. About a mile further south is Mr. Deffenbaugh's bank, which is like the others. In all of these as well, as in others still further south along the township line, the coal is of superior quality.

On the head waters of Yorks run, the *Sewickley coal bed* has been worked quite extensively to supply the local demand. Half a mile south-east from the Grove church it has been opened at the roadside, and is exposed to the extent of 5 feet 8 inches, which is clearly not the full thickness, as there is coal in the drain at the bottom. It is seriously broken by thin, hard clay partings, none of which is persistent. Near the head of the main fork it is mined by Mr. S. A. Fouch, who has it more than 5 feet thick, and on the adjoining farm of J. T. Kyle, it is 5 feet 11 inches. The coal is soft at best, and this defect, added to the numerous binders, makes it poor mining coal. It burns nicely, but leaves much ash and has no inconsiderable proportion of
10—KK.

sulphur. Other openings were seen on this run but they all display the same characters.

The *Pittsburg coal bed* is first reached below Mr. D. Collier's residence, and thence to within a short distance of Smithfield openings in it are frequent. Between Yorks run and the western out-crop of the bed there is a high ridge, unbroken by streams, so that the coal is deeply buried. As the run approaches the township line the effects of erosion become greater and the available area of the coal becomes wider. The out-crop crosses the run at about a mile from the border of Nicholson township. The structure of the bed is shown in the following section obtained at Mr. Caldwell's opening near Smithfield :

Roof division,	4' 9"
Main clay parting,	4" to 6"
Lower division,	7 4"

The roof division shows 10 inches of bituminous shale on top and contains three layers of coal, measuring in all, 2 feet 5 inches. The lower division is said to reach 8 feet in some parts of this mine. Several other openings were seen between Smithfield and Yorks run, but they all resemble that just given.

Along the road to Ice's ferry, which leaves the Morgantown road just south from the township line, the *Uniontown coal bed* is shown near the junction of the two roads, but no further exposure occurs until opposite Mr. J. Oliphant's residence, where, on the west side of the road, the *Sewickley bed* was once opened. The opening has been deserted for several years and no direct measurement can be made; but the bed is said to be about 5 feet 6 inches thick, and to yield coal similar in quality to that obtained from other banks in the township. The limestones between this and the *Uniontown coal bed* seem to be wholly concealed.

At this place a road turns off, leading to Mr. F. H. Oliphant's furnace. On the furnace property, the *Pittsburg coal* is continuously exposed for a distance of nearly one third of a mile along the edge of a bench where it has a cover of from two to six feet. For six or eight feet from the out-crop the coal is sufficiently unsound to yield a some-

what inferior coke, but beyond that it is of excellent quality and gives a coke, which is said to burn evenly and to show no tendency to form shelves or caves in the furnace. The coke is made by burning the coal in the open air in heaps of three to four hundred bushels, the roasting being continued for six days. The section of the bed is:

Roof Division,	—		
Coal,	8"	} 4'	} 15' 7"
Clay,	8"		
Coal,	10"		
Dark lam. shale,	1' 6"		
Coal,	4"		
Main clay parting,	2' 6"		
Lower division,	9' 1"		

In the lower division there are ten distinct partings, but the bed is broken into only six well-defined benches, which are 25, 8, 4, 14, 10, and 48 inches respectively. All of the partings are pyritous and they seem to carry nearly all the pyrites found in the bed.

This furnace depends altogether on the Pittsburg Group of ores, though some of the Umbral ores are occasionally purchased from persons who bring them in. But those at the furnace are in such quantity and so easily accessible that no attempt is made to procure ore from any of the other groups. The section continued below the coal is:

1. Clay,	4'
2. Blue lump ore,	0' 8"
3. Clay,	0' 6" to 8"
4. Condemned flag ore,	0' 4"
5. Clay,	2' 6"
6. Big Bottom ore,	1' 8" to 5"
7. Clay,	2'
8. Red flag ore,	0' 2"
9. Clay,	1'
10. Yellow flag ore,	0' 4"

The Blue Lump occurs here in lenticular nodules, 2 to 6 inches thick and 3 to 18 inches long, which are closely packed together, so as to form an almost continuous layer. They are concretionary and, near the out-crop, where they have been long exposed to the weather, they are scaly and readily split into thin laminæ, leaving a core which does not break up. The ore is reddish-blue with thin streaks of

calcspar. It is easily reduced and yields an iron of remarkable excellence.

The other ores in the column are all flag or plate ores. They show no tendency to become nodular but form continuous plates. No. 4 is variable in quality, though fairly persistent in thickness. Sometimes it is very good. The Big Bottom is very regular and comes out in fine blocks, showing the full thickness of the layer. It is very compact, heavy and has a dull brownish-gray color. It varies from 14 to 20 inches in thickness and in quality is thought to be but little inferior to the Blue Lump. The Red Flag is dull red and earthy looking, with a slaty fracture, and forms a continuous plate varying little from 2 inches in thickness. Flags of it can be taken out of any desired size, which break into strips 2 to 3 inches wide and several feet long. It is said to be a very fair ore, and is taken out wherever it is available. The Yellow Flag is much like the last and seems to differ chiefly in color. It is equally good and varies little in thickness.

Thus far these ores have been obtained by benching after the removal of the overlying coal. The price is two dollars per ton delivered at the furnace, making the cost of ore per ton of metal somewhat less than six dollars, while the coke costs less than two cents per bushel. A considerable extent of bottom land lies just east from the coal out-crop and contains these ores, which can be benched there at less cost than at the present workings. At the time the property was visited these ores were exposed for fully one third of a mile and the available quantity seems, for all practical purposes, to be almost inexhaustible.

Returning to the Ice's Ferry road, the blossom of the *Sewickley bed* is seen twice before one comes to the *Pittsburg*. The out-crop of the latter constantly approaches the road and finally reaches it at a short distance beyond Rogers run. For nearly two thirds of a mile south from that run, the line of out-crop extends for a few yards east from the road, after which it turns sharply westward, crossing the road and the run. The direction is turned more and more westward until the line crosses the Morgan-

town road at a little distance north from Smithfield. It crosses the Ice's Ferry road nearly a mile north from Fairchance furnace. From that point to the line of Springhill township, the road lies wholly within the Lower Barren Series. Occasional exposures of sandstone and shale occur but they are so disconnected and characterless that their relative places cannot be determined with any degree of certainty.

Fairchance furnace depended in great measure upon the ores of the Pittsburg group, from which was manufactured the iron which gave Mr. Oliphant such reputation many years ago. These ores are the same with those at Mr. Oliphant's new furnace, two miles further north, but the intervals are different from those in the section at that place. The workings give no information, for the Fairchance company, the present owners of the property, have permitted them to lie idle for several years. The section furnished to me is as follows:

1. Pittsburg coal bed,	9'
2. Clay,	5'
3. Blue lump ore,	6"
4. Clay,	4"
5. Condemned flag ore,	8"
6. Big bottom ore,	1'
7. Shale,	5'
8. Red flag ore,	3"
9. Shale,	3'
10. Yellow flag ore,	6"

The important ores are 3, 5, and 6. No. 5 is occasionally 1 foot, and No. 6 has been found 2 feet thick. For the most part, the ores were procured by stripping, and the benching has been carried on to a great extent. These diggings reach along the Ice's Ferry road for more than a mile and a half north from the furnace. In former times some valuable ores, known as the Snake Den and Fairchance, were obtained in the hollows opening out near the furnace. These are persistent southward, having been identified in Springhill township, while the former has been recognized in West Virginia, near Cheat river, by Prof. W. B. Rogers. As these have not been worked for a number of years, I was unable to ascertain their character, and at the time the local-

ity was visited their position could not be accurately determined. The Umbral ores were worked in a similar manner, but nothing has been done with them for three years. I am informed, however, that they differ in no respect from the same series as shown in Springhill. It is unfortunate that the ores of the Lower Barren Series are concealed here beyond recognition, as the openings at Fairchance and Springhill were so extensive that they would have afforded a key to this annoying portion of the section.

Half a mile south from the furnace a road turns off into the mountain and follows Black creek. At rather more than a mile and a half up this road the *Upper Freeport coal bed* is worked by Mr. Jonathan Low, whose bank shows:

1. Shale, with streaks of coal,	3' 0"	} 12' 4"
2. Coal,	1' 4"	
3. Clay,	0' 1"	
4. Coal,	2' 6"	
5. Clay,	0' 3"	
6. Coal,	1' 8"	
7. Clay,	0' 8"	
8. Coal,	3' 0"	

The roof is very insecure and must be timbered as well as propped. The dip is excessive, for, at a horizontal distance of only 50 feet from this opening, the same bed is worked by Mr. Esau Harden, at 25 feet lower down the hill. In the Harden bank the section is the same, except that the clay, No. 7, is 11 inches thick, and a thin clay parting is seen at three inches from the bottom of No. 6. The best coal is in No. 8. The blacksmith at Fairchance thinks it to be of good quality, as he finds no difficulty in using it. Above this there are no exposures until near the summit, where the Conglomerate and the Umbral Limestone are exposed.

Near Haydentown the coal, 75 feet below the Green limestone, in Springhill, is worked, and is about 4 feet thick. At some distance back of this, behind the low foothills, the *Upper Freeport coal bed* is seen, and has been rudely opened along its face. No measurement could be obtained. On this as well as on the next run south the Umbral ores were mined years ago to supply the Victor iron-works, and later to supply Fairchance furnace, but they are no longer ex-

posed. The Umbral Limestone is reached at the heads of these streams, and its upper layers yield a lime of remarkable whiteness. The lower layers are sandy, but if carefully burned give a lime which is excellent for building purposes.

No further exposures occur along the face of the mountain, southward to the Springhill line. A small patch of the *Pittsburg coal bed* remains between the two forks of Georges creek, about a mile west from Haydentown, and is worked by Mr. Hibbs and Mr. Moser.

3. SOUTH UNION TOWNSHIP, OF FAYETTE COUNTY.

This lies north from Georges, and is separated from North Union by the National road. For convenience, the line of that road to the base of the mountain will be described as lying wholly within this township. The exposed section extends from the *Waynesburg coal bed* to the Catskill rocks, the latter being exposed on the west flank of Laurel (Chestnut) hill. The synclinal between the Saltsburg axis and Laurel hill passes through the township, entering it about one eighth of a mile east from the Morgantown road, and crosses that road about a mile from the court-house, in Uniontown.

At the western line, the *Pittsburg coal bed* is mined on both sides of the National road, the opening, in South Union, belonging to Mr. J. Snyder, and that in North Union to Mr. H. Gaddis. The structure is the same in both, being:

1. Clay and shale, 4' 0"
2. Roof division, 2' 6"
3. Main clay parting, 1' 2"
4. Lower division, 8' 6"

The roof division is in five layers, three of coal, 5, 10, and 5 inches, and two of clay, 4 and 6 inches thick. The lower division is in six benches, 34, 14, 12, 4, 15, and 24 inches thick. The thickness of the lower bottom is given on information, as only one foot of it was exposed. The partings are very thin, excepting those above and below the second bench, which occasionally become an inch thick. They consist of hard carbonaceous clay, almost a bone coal. The

partings defining the fourth, or bearing-in bench are thin, but distinct. The lower bottom is very soft, contains numerous lumps of pyrites, and is not removed. At 5 feet under the coal, iron ore has been found, 18 inches thick, but no explorations have been made to ascertain whether or not any of the lower layers of the series are present. The dip at this bank is rather more than 330 feet per mile toward the south-east.

On a hill by the road, the *Sewickley coal bed* is imperfectly exposed under a sandstone, and its limestone is seen in fragments below. At the top of the hill, the lower division of the Great Limestone is shown in the road by the poor-house, and has a coal blossom resting on it. From this point, there are no exposures directly on the pike, except one of the *Uniontown coal*, at Coal Lick run, until the bridge is reached at the east end of Uniontown, where the *Uniontown coal bed* is seen again. It was once mined here, and was found to be 30 inches thick. Its limestone is exposed under it, while above the coal is a thick sandstone, which is quarried for flags. The blossom of this coal is again seen in the village of Hayti, that exposure being on the eastern out-crop.

At the cross-roads, about a mile east from Uniontown, the lower division of the Great Limestone is seen in the road, but is very imperfectly exposed. It seems to be very thin, but its thickness, north and south from this locality, renders probable that the rock is concealed here by debris. Below it is the sandstone, which in this basin overlies the *Sewickley coal bed*, and at a little distance further that coal bed is mined. It is 58 inches thick, and yields a very good coal. Half a mile from the village of Monroe, the *Redstone coal bed* is shown in the road, at 35 feet below the *Sewickley*, and 18 inches thick. Almost directly below it is the Redstone Limestone, about 4 feet thick, and of a bright buff color. Between the two coals there is no exposure.

Fifty feet below the *Redstone* is the *Pittsburg coal bed*, which is mined on Mrs. Hopwood's property, on the north side of the road. Above it is sandy shale to the Redstone Limestone. The exposure at this opening is :

1. Sandy shale, 5' 0"
2. Carbonaceous shale, 4' 0"
3. Coal, seen, 8' 4"

The roof division has disappeared wholly, and the carbon seems to be equally distributed throughout the shale No. 2. The top bench of the coal is 29 inches, below which is another, 4 to 6 inches, with a well-defined parting on each side. The old bearing-in bench is at 57 inches from the top. At many places in this bank, the coal is broken by irregular sooty layers from one half inch to 2 inches thick. This is on the eastern out-crop of the bed.

Where the road to New Salem leaves the pike at the county poor-house, the top of the Great Limestone, lower division, is seen with a coal blossom resting on it. At the first summit, only a short distance from the pike, the *Uniontown coal bed* is shown with the limestones above and below it. The upper rock is dark blue and slaty above and somewhat ferruginous in the lower layer. The underlying limestone contains some ferruginous layers, but it is not wholly exposed. At the next summit the coal resting on the lower division of the Great Limestone is again reached and makes a very considerable blossom. The limestone itself is very imperfectly exposed, but enough is seen to show that the mass is double, the parts being separated by a compact sandstone. The *Pittsburg coal bed* comes to the surface at a short distance from the township line, but is not mined.

On the McClellandtown road the *Uniontown coal bed* is exposed by its blossom near the pike. Beyond this to the township line there are no exposures except imperfect ones of the Fishpot Limestone. The *Pittsburg coal bed* is not reached along this road within the township.

On a little run crossing the pike at the western edge of Uniontown, and known as Coal Lick run, the *Uniontown coal bed* is seen for nearly two miles above the National road. An exposure on this stream near the pike shows:

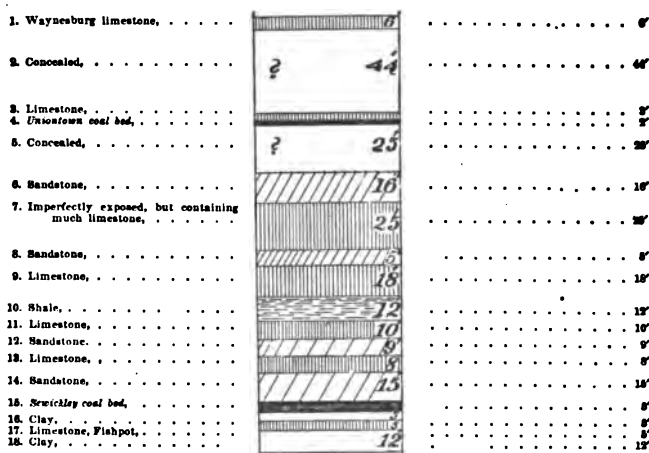
- | | | |
|-------|-----------|-------|
| Coal, | | 1' 6" |
| Clay, | | 0' 5" |
| Coal, | | 1' 6" |

The lower division contains a sooty layer at nine inches

from the base. On the first road crossing the run the blossom of the *Waynesburg coal bed* is shown. A narrow roll crosses the run between these points at about one third of a mile south from the pike and thence the coal dips in both directions.

On the Morgantown road the *Waynesburg coal* is first reached at about half a mile from Uniontown. Sandstone is seen both above and below it. The upper one is curiously cross-bedded, and the layers are very thin. Here the dip is distinctly south-east. At the next fork in the road the coal is seen again and at a short distance east is an old opening in the *Uniontown coal bed* on the property belonging to Mr. Ritchie. This bed is said to be 3 feet thick here, with a clay parting about midway. The road turning off here and leading to Fleatown, lies for the most part on the horizon of the upper or Uniontown division of the Great Limestone. Within this township, on the Morgantown road, the *Waynesburg coal bed* is occasionally exposed to within a short distance of the Georges township line, where it runs out. It is not far from 17 inches thick, but no openings exist, so that its thickness cannot be made out with absolute accuracy.

Fig. 15.



Upper Coals on Redstone Creek.

On the first road east from that leading to Morgantown, the

Waynesburg coal bed is reached at the fork near Mr. W. H. Bailey's property. Between this and Redstone creek the preceding section was obtained.

The portion of the section below No. 14 was obtained on a little branch of Redstone flowing through Dr. Fuller's property.

The *Uniontown coal bed* is double at this exposure, but only 3 inches of the lower bench could be reached. No openings in it have been worked for many years. The upper or Uniontown division of the Great Limestone is concealed, and it is difficult from the road exposures to determine how much of limestone is contained in the interval No. 7. In an adjoining field, on Mr. Bailey's property, a limestone belonging to this interval was once quarried and was found to be about 6 feet thick. Nos. 9 and 11 are quarried on the same property and are said to yield a good lime. The former is regarded as being somewhat better than the latter. Nos. 11 and 13 are marked features along the stream for some distance. The total of limestone in this lower division, as far as can be determined from the exposures, is 42 feet in four strata, distributed through a vertical space of about 70 feet.

The *Sewickley coal bed* has been opened on Dr. Fuller's property, at a little distance from the road, where it shows:

Coal,	2' 8"
Clay,	0' 1"
Coal,	2' 8"

Though it contains enough pyrites to stain the out-crop with copperas, it is said to be a superior gas coal and to have proved better than the *Pittsburg* when subjected to comparative tests at the Uniontown gas-works. The bed is much twisted and is badly troubled by sandstone horse-backs. One of these, at a few yards from the mouth of the pit, has removed nearly the whole of the upper bench. The roof is very insecure, and for a thickness of four feet it is merely a contorted sandstone, containing layers of clay which is more or less carbonaceous. Fissures extend through the sandstone. The Fishpot Limestone is very thin, and some of it contains a good deal of iron; but the

greater portion is a fine blue rock with much spar, which is said to yield excellent lime. The *Redstone coal bed* is exposed at a short distance further up the run, and is 18 inches thick.

Returning to the creek and taking the road to Hutchinson's mill, one finds the *Sewickley* and *Redstone coal beds* on the divide between the forks of the stream. The *Pittsburg* is worked just west from the railroad, and at a little way off the road, by Dr. Fuller. The dip here is between three and four degrees, and the bed has been opened at several places along the out-crop, the working being continued until water became troublesome. Some of these openings are more than fifty years old. As at the Hopwood pit on the pike, the roof division is wanting and the shale immediately over the coal is carbonaceous, but graduates imperceptibly into the ordinary shale above. The coal is in six benches, 29, 25, 5, 2, 14, and 20 inches thick. The partings are all very thin, but they seem to be persistent as far as the bed was followed in these openings. In the upper two benches, the coal is tough enough to bear shipping and is free from pyrites in lumps, though it contains occasional streaks. The bottom benches are soft, but very rich in volatile combustible matter and yield the best coking coal. Lumps of pyrites are of frequent occurrence, but they are easily separated. This distinction between the two portions of the bed seems to prevail along the eastern out-crop. The section below the coal is as follows :

1. Clay,	4' 0"
2. Blue Lump ore,	1' 0"
3. Clay,	3' 0"
4. Big Bottom ore,	0' 10"
5. Clay,	0' 10"
6. Red Flag ore,	0' 2"

No examination has been made to ascertain the presence of the Yellow Flag ore. The Blue Lump varies from 8 to 18 inches. For many years it was obtained from the broad bottom here by stripping, and was reduced at the old Redstone furnace, half a mile north from this locality. It yielded a most excellent pig metal, which in the early part

of the rebellion was sold to the Government for eighty dollars per ton, to be used in the manufacture of guns.

This is the extreme out-crop of the coal. Between it and the mountain is a broad valley, scooped out of the Lower Barren Series, with rarely an exposure of any sort. At Hutchinson's mill, somewhat more than half a mile south from the village of Monroe, on the Pike, Mr. Isaac Hutchinson made a boring, beginning at the Morgantown Sandstone, or about 180 feet below the *Pittsburg coal bed*. The record was kept with such care as to justify me in publishing it here in a somewhat condensed form. It is as follows:

1. Sandstone,	18'	}	198'
2. Black shale,	1'		
3. Blue clay,	2'		
4. Limestone,	9'		
5. Variegated shale,	55'		
6. Sandstone,	4'		
7. Shale,	25'		
8. Hard sandstone,	6'		
9. Shale, with limestone,	89'		
10. Blue clay,	2'	}	86'
11. Black shale,	9'		
12. Hard sandstone,	6'		
13. Shale,	22'		
14. <i>Coal bed</i> ,	1'	}	107'
15. Shale,	26'		
16. Limestone,	5'		
17. Variegated shale,	15'		
18. Sandstone,	8'		
19. Shale,	4'		
20. Sandstone,	21'		
21. Black shale,	12'	}	
22. <i>Upper Freeport coal bed</i> ,	6'		
23. Shale,	6'		
24. Sandstone,	13'	}	
25. Red shale,	23'		
26. Conglomerate sandstone,	6'		
27. Shale,	5'		
28. Sandstone,	14'		
29. Shale,	3'		
30. Sandstone,	8'		
31. Black shale,	29'	}	
32. <i>Mount Savage (?) coal bed</i> ,	8'		
33. Shale, with thin sandstone,	30'		
34. Pottsville conglomerate,	60'		
35. Shale, with iron ore,	70'		
36. <i>Coal bed</i> ,	4'		
37. Shale,	12'		

38. Limestone,	47'
39. Sandstone,	15'
40. Shale,	16'
41. Sandstone,	17'
42. Shale,	5'
43. Coal bed,	3'
44. Black shale,	25'
45. Sandstone,	2'
46. Shale,	20'
47. Sandstone,	18'

Some uncertainty prevails respecting the thickness of No. 36, and the bed may be only 2 feet. No. 31 was found to be extremely hard, so that the drill would penetrate barely an inch or two in a day. This rock is very fetid, and was known among the workmen as the "sulphur rock." Flowing water was struck at 198 feet, but neither brine nor oil was obtained, though the Umbral Limestone, No. 38, gave off a faint odor of petroleum.

Lick Hollow is a deep excavation alongside of the National road, extending for two or three miles into the side of the mountain. Near its mouth a coal bed has been found on the hillside, which, from its position, I take to be the *Upper Freeport*. There is an old opening in the *Mount Savage (?) coal bed*, at a short distance further up the hollow, which was worked only a couple of years ago; but unfortunately the roof has fallen at the mouth so as to conceal all traces of the coal. The bed is said to have 7 feet of workable coal, all of it good. Ascending the hollow, one soon sees the Conglomerate and the Umbral Limestone, both of them ill-exposed. The lower or sandy portion of the latter is known as "whinstone," and is 15 feet thick. Below this everything is concealed, but at a mile and a half further up the run, Colonel Ewing Brownfield made a boring for salt some years ago, beginning fully 600 feet below the bottom of Mr. Hutchinson's boring. The record is a curious one, and cannot be verified, as the rocks pierced in the boring are not reached at any exposure within the district. Much condensed, it is as follows:

1. Sandstones and variegated shales,	148'
2. Limestone,	8'
3. Sandstone and variegated shale,	205'
4. Limestone,	7'

5. Sandstone,	14'
6. Limestone?	8'
7. Sandstone and red shale,	101'
8. Limestone,	52'
9. Sandstone and shale,	64'

Salt was obtained at 407 and 568 feet from the surface. At first the flow was considerable, but after three day's pumping it dwindled, until the stream became insignificant. The brine was very poor. For many years a strong salt spring had flowed within a few feet of the well-curb, and the boring was made with the hope of reaching the reservoir. The limestones of the section are so numerous, as to render doubtful the accuracy of the record, though No. 8 may represent that marking the base of the Catskill group.

South from this hollow is Piney Knob, a bold promontory which, viewed from the valley, seems to be a separate mountain standing out from the main range. As seen in profile, it is connected with the greater mass by a high hog-back ridge, but almost cut off by the tributaries to Lick Hollow on the north, and by the main gorge of Redstone creek at the south. The whole face toward the valley is capped by the Pottsville Conglomerate, which forms a high bluff at the crest, and is distinctly traceable all the way down its side, as seen from the National road.

On the main fork of Redstone creek, the *Upper Freeport coal bed* is mined by Mr. J. C. Beeson, at whose opening the following section was obtained:

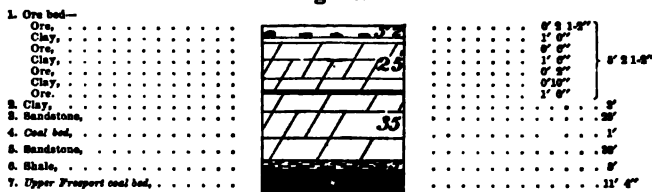
1. Coal,	0' 10"	} 11' 4"
2. Clay,	1' 2"	
3. Coal,	1' 8"	
4. Clay,	0' 0½"	
5. Coal,	0' 8"	
6. Clay,	0' 2'	
7. Coal,	1' 6"	
8. Clay,	1' 4"	
9. Coal,	3' 0"	
10. Coal and slate,	1' 0"	

No. 9 could not be examined in detail, as it was freshly opened with a pick for examination, and proved to be so soft near the outcrop that no partings could be made out. The lowest layer, No. 10, was reached, but not fairly exposed, and the thickness is given on the authority of Mr.

Beeson. The coal from No. 9 is said to be of extremely good quality, and much superior to that from the upper portions of the bed. The same coal has been opened on an adjoining run.

At a little distance further up the creek an iron ore is exposed, whose structure and relation to the *Upper Freeport* are shown in the following section :

Fig. 16.



On Upper Redstone Creek.

The measurements of the ore were made in an excavation about fifteen feet square, which exposes only the outcrop, so that they afford no definite data for calculation. The material is calcareous and is the same with that already referred to in the description of Springhill township as the Johnstown ore. Locally it is known as the Hardman Ore. Nos. 3, 4, and 5 are the Mahoning Sandstone. The little coal is not fully exposed, but it is said to have been found 18 inches thick in an opening made near the old mill. The ore has been observed at several places along the creek.

About a mile above Mr. Beeson's bank, there is an old opening in the *Mt. Savage (?) coal bed*, which, unfortunately, is now closed. No coal has been taken from it for many years and I was unable to find any person who had ever digged in it. Statements respecting its thickness vary much, giving it from 7 to 12 feet, but all accounts agree in stating that the amount of available coal was little more than four feet. No ore has been discovered above it, but at barely ten feet below it is a very good ore belonging to the *Mt. Savage (?) group*, and known locally as the Mahan Ore. In a drift freshly opened and extending about 60 feet, it is well exposed and seems to average about 4 feet 6 inches. It is not more than 20 feet above the Conglomerate, on which rests a bed of fireclay.

Many years ago one of the Umbral Ores was mined for Fairchance furnace by benching on the hill south from the creek. From the present exposure one cannot determine positively whether this is the Big Honeycomb or the Big Bottom, but the shale on the dump greatly resembles that usually associated with the latter.

The hollow of Redstone creek cuts deeply into the mountain but gives little in the way of exposures. The Conglomerate is distinct on both sides and the Umbral Limestone is well exposed in Spruce hollow. Of the lower rocks none is well shown. Along this main hollow the Umbral Ores should be thoroughly available, and the grade thence to the valley is so small that a narrow gauge railroad could be easily constructed.

4. NORTH UNION TOWNSHIP, OF FAYETTE COUNTY.

This lies directly north from South Union. The section extends from the *Waynesburg coal bed* to the Catskill rocks, as the township extends eastward to the summit of Laurel (Chestnut) hill. The geology along the National road west from the base of the mountain has already been given in the description of South Union township.

On the National road, at the county poor-house, the lower division of the Great Limestone is seen with a coal blossom immediately above it. On the road turning north, at this place, there are no exposures until Jennings run, the western boundary of the township, is reached, where the *Pittsburg coal bed* is mined, on the properties of Dr. Fuller, Mr. Gaddis, and the Swan heirs. Its dip is one foot in eleven, or nearly 500 feet per mile. The roof division is almost 5 feet thick, and consists chiefly of clay, while the little coal which it does contain is worthless. The lower division is in six benches, 28, 15, 24, 8, 16, and 18 inches thick. The coal is soft and quite clean. At 3 feet below the bed, iron ore is said to have been found, 18 to 20 inches thick, but the excavations have all been filled up, and nothing is exposed.

At Uniontown, the *Uniontown coal bed* is well shown at the cement quarries, where the section is:

11—KK.

1. Debris,	—
2. Shale,	15' 0"
3. Bituminous shale,	1' 0"
4. Limestone,	1' 6"
5. Sandy shale,	1' 0"
6. Shale,	3' 0"
7. <i>Uniontown Coal Bed</i> ,	—
Coal,	1' 5"
Clay and Coal,	0' 2"
Clay,	0' 2"
Coal,	1' 5"
8. Clay,	0' 6"
9. Limestone,	1' 0"
10. Clay, with nodular limestone,	3' 0"
11. Limestone, seen,	10' 0"

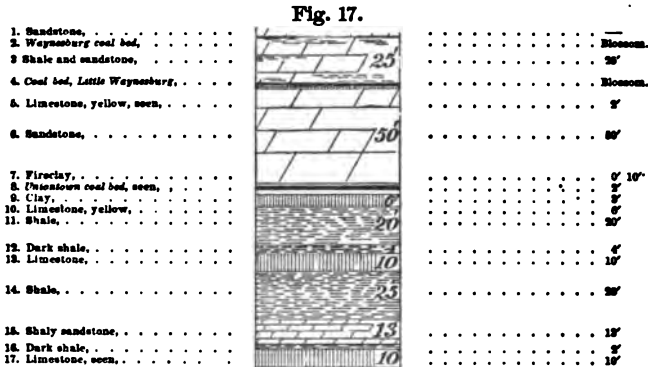
The bituminous shale, No. 3, is slightly calcareous, and, hastily examined, might be mistaken for limestone, the weathered surface being smooth and dark blue. It contains many vegetable fragments, all of them indistinct, together with minute teeth of fish. The coal is inferior, and is not used for any purpose. The limestone, No. 11, is manufactured into cement, which has a considerable local reputation, and is employed at the Government works, on the Monongahela river.

Turning here north of north-west, and following the old Pittsburg road, one frequently sees the *Uniontown coal*, which is rising sharply toward the north-west. At two miles from Uniontown, the lower division of the Great Limestone is imperfectly exposed, and at the cross-roads the *Pittsburg coal bed* is reached. This point is on the western out-crop of that bed, in the Blairsville trough. Half a mile further on, the Green Fossiliferous Limestone is shown at the roadside by Mr. J. Gaddis' residence. It is barely 18 inches thick, and shows its characteristic method of weathering into sharp blocks.

On the old Connellsville road, between Uniontown and Shutes run, the *Uniontown coal bed* is occasionally exposed, but the limestone and carbonaceous shale, overlying it at many localities, are absent. This is the case also at an exposure west from this road, and just north from the mouth of Shutes run, where the bed seems to be about 3 feet thick. The bed is exposed in the road, at three fourths of a mile

north from the run. On the run it has been opened by Mr. Foster, half a mile west from the old Connellsville road. No mining had been done here for more than a year, and, at the time of examination, the bank contained so much water, that only the top bench of the coal could be seen. The total thickness is said to be 3 feet; and the coal is not very bad. The overlying shale and limestone are present here. This bed is well exposed along the South-West Pennsylvania railroad, at a short distance outside of Uniontown.

On the new Connellsville road, the *Uniontown coal bed* is exposed near the National pike, and at a mile further, the following section was obtained in descending the hill to Shutes run:



Upper Coals on Shutes Run.

Here the *Uniontown coal* is without its shale and limestone, though they are both present at Foster's bank. No. 17 is a magnesian rock and belongs to the lower division of the Great Limestone. The *Sewickley coal bed* is reached at a little distance east from this, and the *Redstone* is exposed on the road leading up Shutes run. The *Pittsburg* is mined on its outcrop here by Col. James Evans.

On the Connellsville road, about a mile north from Shutes run, the *Uniontown coal bed* was worked many years ago by Mr. J. McDowell, but the opening long since fell in. The bed is said to be 4 feet thick at this pit, but the coal is not good enough to repay working, while the *Pittsburg* is accessible within two miles.

At a short distance west from the village of Monroe, and directly north from the National road, the *Pittsburg* is mined on the property of Mrs. Hopwood. It is opened also on Mr. Beeson's land, and on Mr. Beatty's, about two miles north from Monroe. At the latter locality, the following section was observed below the coal:

1. Clay,	4' 0"
2. Blue Lump ore,	0' 6"
3. Clay,	1' 6"
4. Flag ore,	0' 8"
5. Clay,	0' 4"
6. Big Bottom ore,	1' 6"
7. Clay,	2' 0"
8. Yellow Flag ore,	0' 3"

The Blue Lump is clean and thoroughly persistent. No. 4 is laminated and contains more or less coal. It is a close layer, made up of overlapping lenticular pieces six to ten inches wide and long. This ore is irregular in quality, but is seldom bad. It is clearly equivalent to the Condemned Flag. No. 6 is constant in thickness. No. 8 has not been mined to any extent, owing to its distance below the other layers. Whether this be the Yellow Flag of Mr. Oliphant's series I am unable to determine, as the stratum was not fairly exposed at the time of examination, and no specimens could be procured for examination. Its position would show it to be more probably the Red Flag. Sometimes the intervening clays of the section disappear and permit the ores to come together, so as to form a single layer about 3 feet thick. The mining is done by stripping, and the ores are shipped to Dunbar and Lemont furnaces.

The *Sewickley coal* was formerly worked on the hill above the ore-pits, but the opening has fallen in. The bed is said to be 5 feet thick.

Passing south-east, one soon crosses the valley separating the outcrop of the *Pittsburg* from the lower ridge of the Lower Barren Series, at the foot of the mountain. Behind this, and still on the Beatty estate, is an old opening in the *Upper Freeport coal bed*, known as the Shipley bank, which gives the following section:

1. Coal,	8'	0''	} 7' 6" to 11' 4"
2. Clay,	4'	to 2''	
3. Coal,	3'	0''	
4. Hard clay,	0'	4''	
5. Coal, worked,	1'	0''	

As the opening is in a state of sad decay, no measurements can be made, and I am indebted to Mr. W. Sullivan for details of the section. The top 10 inches are worthless, and under them is a cannel-like shale 4 inches thick. The coal from the rest of the bed is said to be very good. The roof is sandstone, sometimes separated from the coal by 3 to 5 feet of shale. No direct measurement can be made, but this sandstone, which represents the Mahoning, seems to be about 30 or 35 feet thick, and almost directly on it rests the Johnstown ore, which has been mined by stripping at several places. It is exposed at half a mile north east from this coal bank, and is a compact mass 2 feet 6 inches thick.

Passing up the mountain one soon crosses the Conglomerate, and comes to the Umbral Ores. The whole series is present, but the Big Bottom alone is mined. At the end of the drift it is in two layers, separated by clay, as follows:

Ore, 8 to 10 inches; hard clay, 3 to 4 feet; ore, 5 to 10 inches.

The layers are very regular, there being no troubles, and the ore is exceedingly clean.

Crossing over the hill, a distance of barely half a mile, one reaches the National road about a mile south-east from the village of Monroe. Here the Umbral Limestone was formerly quarried for use on the road, and the exposure seems to indicate a thickness of not far from 40 feet. The upper portion is light blue, and contains many fossils replaced by calcspar; the middle is dull blue, somewhat clayey, and contains many fossils, though the species are few. Below this is a rude mass of clay, shale, and argillaceous sandstone, separating it from the bottom portion, which is extremely sandy, and is known here as "whinstone." It burns well enough, but is so sandy that the lime makes a fair mortar without the addition of sand.

Beginning at the summit of the mountain, and descending to Monroe, the following is found to be the succession. At the summit there is a sandstone of unknown thickness, only 20 or 30 feet being exposed, which contains conglomerate layers, 6 to 10 inches thick. Large fragments of it are found in the ravine back of the Summit house, and its top layers are well shown along the pike for some distance from the summit, dipping with the grade of the road. On it rests a mass of dull reddish shale, with irregular layers of clayey sandstone, the whole not far from 100 feet thick. This dips very nearly with the road, and at the Turkey Nest, somewhat more than a mile from Monroe, the Vespertine Sandstone is reached, dipping at a tremendous angle almost in the direction of the strike. The appearance here seems to indicate that the twisting of the dip is due to a slide, but the exposure is not sufficient to make the matter clear. Along the line of this axis such phenomena as this are not unusual, and Prof. Lesley informs me that at one locality, further north, on the crest of the axis, he found the dip abruptly increasing from 10 to 80 degrees. It is by no means impossible that a similar condition exists here. This sandstone is light-colored and very pure, showing hardly a trace of feldspar. The layers are thin, and the rock has been used as a firestone, for which purpose it seems to be admirably adapted. Between it and the Umbral Limestone only shales and sandstones occur, the interval, as estimated being between 300 and 400 feet. From the Umbral Limestone to the mountain Big Bottom ore, the following section was made out along the road:

1. Big Bottom ore,	—	} Interval. 123'
2. Shale,	15'	
3. Sandstone,	25'	
4. Shale,	18'	
5. Sandstone,	25'	
6. Concealed,	40'	
7. Umbral Limestone,	—	

The Big Bottom and Kidney ores are exposed at the roadside, but the latter is very thin.

Below this, along the road, the exposures of the higher rocks are unsatisfactory. The Mt. Savage (?) *coal bed* is

concealed, but at midway between its place and that of the *Upper Freeport*, there is a small coal bed, 18 inches thick, above which is a sandstone 25 feet thick. The *Upper Freeport* is not exposed. At the foot of the mountain is a massive sandstone belonging to the Lower Barren Series, which is largely quarried for building purposes.

On Shutes run the *Pittsburg coal bed* is mined by Col. Evans near Evans station. Erosion by tributaries to the run has rounded off the surface and cut away the Lower Barren Series, with a great part of the Lower Productive Series, so that instead of the sharp hogback ridges, usually defining the position of these groups, there are only rounded knolls showing no rocks whatever. At a little way below the old Coolspring furnace, the *Mt. Savage (?) coal bed* is mined by Mr. Ritenour, at whose bank the section is:

1. Iron ore,	0' 6"
2. Clay shale,	15' 0"
3. <i>Mt. Savage (?) coal bed</i> ,	—
<i>Coal</i> ,	3' 3"
<i>Clay</i> ,	0' 3"
<i>Coal</i> ,	3' 4"
<i>Clay</i> ,	0' 1"
<i>Coal</i> ,	1' 6"
4. Concealed, estimated,	25' 0"
5. Pottsville conglomerate, seen,	30'

In an adjoining opening formerly worked by Mr. Ritenour, the partings thicken greatly at the expense of the coal, each becoming rather more than one foot thick while the total of the coal is diminished to barely 5 feet. This bed is said to yield good fuel, but owing to the proximity of the *Pittsburg*, little work is done on it. The dip is abrupt and mining is difficult.

The ore above the coal belongs to the Stratford or *Mt. Savage (?)* group. The opening was but recently made and the exposure was not sufficient to justify a positive statement respecting the value of the deposit. It seems not to be bad, but is somewhat sandy. At a short distance further down the run is a curious ferruginous conglomerate which at one time aroused some local excitement. It is a mass of debris, composed of fragments of shale and sandstone, which formed a little "bottom" at the side of the stream

and has been cemented together by bog iron ore from some chalybeate spring, which no longer flows. The line of separation between it and the rocks in place is sharp.

Following up Shutes run, the Pottsville Conglomerate is soon seen forming a fine cliff on both sides of the hollow and about 40 feet thick. One eighth of a mile below Cool-spring furnace, there are numerous drifts on the Umbral Ores, but owing to the difficulty of gaining a good roof, none is mined excepting the Big Bottom. The debris from the old openings has covered the hillside and concealed the section. Mr. W. Sullivan gave me the following as the succession between the Kidney and the Big Bottom, which I have verified on Smiley's hill near by :

1. Kidney ore,	1'
2. Shale,	2' 6"
3. Coal bed,	0' 8"
4. Shale,	4'
5. Coal bed,	0' 9"
6. Shale,	9'
7. Big Bottom ore,	1' 3"

Traces of a little *coal bed* at 15 feet below the Conglomerate were seen here. The Big Bottom is dull dark-gray in color and slaty looking. In appearance it is far from being a promising ore, but the quality is good beyond question. Both the Big and the Little Honeycomb have been mined here and the former has its coal associated with it. The Little Honeycomb was obtained for the old furnace by stripping. As only crop-ore could be reduced with the weak blast then used, the stripping was extensive and deep trenches, made to secure the outcrop of this bed, can be traced for miles around Jude's and Smiley's hills. The Kidney seems to have been neglected on this hill. The interval between the Seral Conglomerate and the Big Bottom ore is 80 feet. An ore belonging to the Stratford or Mt. Savage (?) group was at one time mined by benching along the face of this hill and was locally known as the Jude ore. Its exact position cannot be determined as the benching was done many years ago, and none of the ore now remains in sight. It is said to be about 50 feet above the conglomerate. If so, it

is probably the same with that exposed at Mr. Ritenour's opening on this run.

In the bank of the run opposite Coolspring furnace, the Umbral Limestone is imperfectly exposed, only the argillaceous middle portion being shown. This is quite compact and it was quarried for use as a flux at the furnace. Just north from this, on the Springer property, is a steep hill, whose northern face is very regular and marks almost accurately the dip of the limestone. Ascending this for 800 feet one reaches the final out-crop of the rock. At the base, the sandy layers are seen, but about midway up the hill the upper portion appears, which yields a beautifully white lime.

Lemont furnace is about one third of a mile north from Shutes run, and on the out-crop of the *Pittsburg coal bed*. There the coal had been mined for years by Messrs. Ewing, Boyd & Co., who erected 102 beehive ovens for coking. That firm was succeeded by the Lemont company, and the furnace was built in 1875. The property extends into the mountain, and includes the projection known as Smiley's hill. The *Pittsburg* is mined by an inclined shaft through which also the coal ores were raised. Now, however, these are obtained from a tunnel, somewhat further up the run flowing through the property. The *Sewickley coal bed*, 5 feet thick, was once mined on the hill west from the furnace, and the Fishpot Limestone underlying it is quarried for use as flux. The Redstone Limestone is exposed on the same hill in a quarry with the *Redstone coal bed*, 6 inches thick, at 18 inches above it. Two layers of the Great Limestone, lower division, were quarried for use as flux, but being siliceous, they are no longer employed. Overlying the *Pittsburg coal* is the Pittsburg Sandstone, 40 feet thick and very compact. The *Pittsburg coal bed*, as exposed at a little distance north from the coke works, has the following structure :

Roof division,	3' 7"	} 12" 8"
Main clay partings,	0' 2"	
Lower division,	8' 11"	

The roof has four layers of coal, 6, 6, 18, and 6 inches,

separated by clay layers, respectively 2, 2, and 3 inches thick, the lower division is broken by thin partings into four benches, 41, 19, 6, and 39 inches, each of which contains thin slates, not all of which are persistent. About 18 inches of the top bench is left in the bank to support the roof, but all the rest of the lower division is removed and converted into coke. The roof coal is inferior, and is not used for any purpose.

Below the coal the section is:

1. Clay,	8'
2. Ore bed,	0' 0" to 6"
3. Clay,	0' 9"
4. Ore bed,	
Ore,	1' to 6"
Clay,	0' 4"
Ore,	1' 3" to 4"
	} 1' 10"
5. Clay,	2'
6. Ore bed, Blue Lump, (?)	0' 3" to 6"
7. Clay,	1'
8. Limestone,	2'
9. Clay,	4'
10. Limestone, seen,	2'

The Blue Lump is excessively variable here, so much so indeed, that it is not regarded as of any value. In the broad "bottom," between the coal outcrop and the hill east from the furnace, a stripping was made which disclosed this ore in large quantity, and in quality equal to that obtained at any point further south. But in the underground workings it is altogether changed, if the identification be properly made.

No. 4 is locally known as the Big Bottom and is the most important of the series, averaging fully one foot in thickness. The lower layer is sometimes one foot thick, but is usually thin where the upper is thick. These ores are almost precisely alike, both being compact and rarely slaty, and bear much resemblance to the Big Bottom of the Pittsburgh group as seen further south. They are largely used at the furnace.

Cove run, by which the furnace stands, issues from the mountain, a little way north from Smiley's hill. Its narrow valley separates the hogback of the Barrens from the mountain proper.

On the hill, directly east from the furnace, a thin limestone is seen by the run, which is slaty, contains many fossils, and in its upper portion has a marked tendency to become an iron ore. This seems to be a local condition of the Green or Crinoidal limestone. On the property of Mr. Alex. D. Ewing, at a short distance further up the run, there is a nodular ore, 8 inches thick, which Mr. Ewing has mined, by benching along the edge of the hill for nearly one third of a mile. From this point up the run the following section was obtained :

Fig. 18.

1. Ore, crinoidal L. S.,	.....	0' 8"
2. Concealed, . . . .	.....	10'
3. Limestone, . . . .	.....	5'
4. Flaggy sandstone, .	.....	25'
5. Concealed, . . . .	.....	20'
6. Shale, . . . . .	.....	25'
7. Coal bed, . . . .	.....	1' 6"
8. Shale and clay, . .	.....	55'
9. Fireclay, . . . . .	.....	5'
10. Johnstown ore, . .	.....	2' to 3'
11. Conc'led, estimated,	.....	20'
12. Mahoning sandst'e,	.....	5'
13. <i>U. Freep't C.B.</i> , seen,	.....	2' 8"
14. Conc'led, estimated,	.....	110'
15. Piedmont (?) s'ds'e,	.....	20'

Cove Run.

No. 3 was once opened near where the Crinoidal limestone is exposed. It is ferruginous and earthy, falling to pieces on exposure. It occurs further up the run on the hillside below Mr. Ewing's ore pits. The coal bed, No. 7, is undoubtedly the same with that worked on the Ice's ferry road, near Springhill furnace, and at several localities in Georges township, near and south from Fairchance furnace. On this run it is first reached about a mile from the rail-

road, and 40 feet above the stream. Several openings were seen, but they have all been deserted. The coal is said to be quite good.

No. 10, the Johnstown Ore, has been opened on the furnace property below Mr. Hayden's house, where it is an irregular mass of red shelly ore, about 2 feet 6 inches thick. Half a mile east of south from this opening it has been carefully prospected, and shows a closely packed layer of nodules, from 2 feet 6 inches to 3 feet thick. The same ore has been rudely opened on Mr. Hanan's property, near Cove run, but the locality is accessible only with difficulty, and the bed has not been thoroughly tested. Still further up the run it is found on Mr. Yauger's land, but the quantity is clearly not sufficient to repay working. Tests of this ore made at the furnace proved it to be of superior quality.

On Mr. Hanan's property the *Upper Freeport coal bed* is seen, having a total thickness of 3 feet 3 inches, in three benches, 21, 12, and 5 inches, and its coal is said to be good. From the exposure one cannot determine whether or not the whole thickness of the bed is shown. Between it and the Mahoning Sandstone above is a lead-colored clay, which contains a few lenticular nodules of iron ore, and varies from nothing to 2 feet in thickness. It does not exhibit any impressions of plants. The Mahoning Sandstone as far as exposed is 20 feet thick, is rudely cross-bedded and of rather coarse texture. It contains many fine impressions of *Lepidodendron obovatum*, some of which are several feet long, and indicate stems 8 to 10 inches in diameter. Occasional casts of these are well marked, but the coal matter has entirely disappeared.

The same bed is seen on the property of Mr. Yauger, at the mouth of Chestnut hollow, where it has been opened. Three feet of shale intervene between it and the sandstone. As here exposed the bed is in two benches, 15 and 18 inches thick, separated by 2 inches of clay; but it is more than probable that the whole thickness is not shown. The coal is a good fuel.

From this point up the hollow for 300 yards, everything is concealed; but beyond that a fine sandstone is reached,

not less than 20 feet thick, which rises rapidly above the hollow and forms its walls. Fragments of this lie in the fields at the mouth of the hollow, and are used for building purposes. The interval between this and the *Upper Freeport coal bed*, calculated by the dip, is rather more than 100 feet, possibly 110 feet, so that this must be the Piedmont (?) Sandstone. No further exposures occur along the hollow, which has a rudely north-easterly direction, so that its bed rises quite as rapidly as the rocks, and the Pottsville Conglomerate does not come to the surface. Many years ago the *Mt. Savage (?) coal bed* was worked at the head of the hollow, but the opening has long been deserted, and no information can be obtained respecting either the thickness or quality of the coal.

Along the tramway leading from Lemont furnace to the mountain ores everything is concealed until the Piedmont (?) sandstone is reached, at about a mile from the furnace. At one time a coal bed, probably the *Upper Freeport*, was rudely mined at a little way north from this, but the opening has fallen in, and nothing is known about the coal. The Piedmont (?) Sandstone is very light gray, contains a mere trace of iron, and no traces of feldspar visible to the naked eye. It occurs in thin layers, and might prove good as a fire-stone. This rock forms a conspicuous ledge on the face of the hill for nearly one third of a mile. Between it and the Conglomerate everything is concealed. The latter rock comes up at barely a mile and a half from the furnace, dipping very sharply to the north-west, so that within a very short distance it is fully exposed in a cliff above the roadway. Its texture varies from fine to coarse. In the latter case, it contains pebbles an inch long, while in the former it is as fine-grained as the Piedmont Sandstone. The color varies from reddish white to light gray. This stratum remains in sight to the ore mines, where it occurs only in fragments, which have a honey-combed surface. The section obtained at these mines is as follows :

The ore obtained alongside the tramway and somewhat further down the hill, which is given in the second portion of the section, is thought by some of the diggers to be the Kidney ore, and the *coal*, No. 15, is thought to be the coal bed below the Big Honeycomb. This is an eccentric supposition, and its origin is not easily explained, unless it come from the belief entertained by many of the diggers, that where the Big Honeycomb and Kidney are thick, the Big Bottom is of little value. The structure of this ore at once shows that it is not the Kidney, while its place, 75 feet below the Conglomerate, shows that it is the Big Bottom. At the openings alongside the tramway, it is in three layers, 9, 3, and 5 inches thick, with an irregular lump ore at 6 inches below the last. At the time the locality was examined the out-crop only was exposed, and the compact plates of the ore had not been reached. It was coming out in irregular nodules, as is characteristic of this bed at the crop.

The little coal beds associated with the ores seem to be thoroughly persistent at all the openings on this portion of Smiley's hill. On the other part of the hill the same ores are found, but the Kidney has not been mined here for several years. In some trial openings made at the eastern edge of the Conglomerate, the Little Honeycomb is 4 inches thick and, in one, the Big Bottom showed a compact mass of fully 3 feet. The Big Honeycomb is in one layer, which varies from 5 to 10 inches, while the Big Bottom is double in the tunnels now worked. The latter is 70 feet below the conglomerate, which is about 40 feet thick. At 15 feet below that rock is an 8 inch coal bed which is not exposed on the northern portion of the hill.

From Lemont northward, the out-crop of the *Pittsburg coal bed* constantly approaches the railroad, and at Frost's station crosses it. At that station the coal is mined for coking by Messrs. Frost & Son, and shows a roof 6 feet 3 inches thick, in eight layers, containing 20 inches of coal and 3 feet 3 inches of compact bituminous shale.

The ores below the coal are no longer exposed here. Years

ago they were mined and samples are shown in the office. Mr. Frost gives the following as the succession :

1. <i>Pittsburg coal bed</i> ,	—
2. Hard clay,	8'
3. Ore,	0' 9"
4. Clay,	0' 1"
5. Ore,	0' 10"
6. Clay,	0' 2"
7. Ore,	1' to 1' 8"

No examinations have been made to determine the thickness of the clay underlying No. 7, nor is it known whether or not any ore occurs below it. No. 3 is a rather good looking kidney or lump ore, and seems to be much like an inferior Blue Lump. No. 5 is reddish brown, contains more clay than the last, but the burnt specimens are said to have 45 per cent. of metallic iron. No 6 is grayish brown and evidently of poorer quality than the others. It, like No. 5, is a plate and is accompanied by an irregular layer of lump ore.

5. DUNBAR TOWNSHIP, OF FAYETTE COUNTY.

This lies north from North Union township, and has the Youghiogheny river for its northern boundary. Midway, Dunbar creek flows northward to the river, taking its rise in Laurel (Chestnut) hill, back of the high knob known as Dunbar's camp. The section extends from fully 750 feet above the *Pittsburg coal bed* to the Catskill rocks, the latter being exposed in the gap of the Youghiogheny river. That portion of the section above the *Uniontown coal bed* is not satisfactorily shown at any point, and the thickness is given by estimation. The greater thickness of rock found here along the central line of the trough, is due to the fact that in this large township there is no east and west stream like Redstone cutting across it; while, excepting Dunbar creek which runs along the base of the mountain, the streams flowing northward to the river are of insignificant size.

In the north-west corner of the township, a deep trough cut by a stream entering the river at East Liberty, exposes the *Pittsburg coal bed* for about two miles, near the west-

ern outcrop. The outcrop line, as shown on the map, reaches the river at a little way below East Liberty, follows an irregular course to a short distance above the village of New Alexandria, where it curves sharply toward the north. Soon turning again to the south-south-west, it passes into Franklin township. Along the river line the coal comes down to the stream almost opposite Broadford. Near East Liberty it is mined by Mr. Hill, at whose opening the roof is 5 feet 1 inch thick, and contains in all probably 21 inches of coal. The main clay parting is 8 inches, and the lower division is exposed to the thickness of 6 feet. At a little way south-east from New Alexandria, Mr. Hair's bank shows the lower division to be 9 feet. At half a mile further, the *Uniontown coal* has been opened, and the limestone below it has been burnt into lime. On the road leading from East Liberty to Uniontown, Mr. Harper mines the *Pittsburg coal bed* very near the township line, and at his bank the exposure is as follows:

Roof division,	3' 8"	} 12' 1"
Main clay parting,	0' 5"	
Lower division,	8' 0"	

The roof division consists of nine layers, five of which are of coal, aggregating 2 feet 1 inch. In the lower division there are partings at 48, 68, and 71 inches from the clay; and for 2 feet at the base the coal shows binders, but no persistent partings. This bed is seen at the roadside quite to the township line, where it passes under the surface.

In the central portion of the township, along the axial line of the Blairsville trough, the Upper Washington limestone should certainly be caught by some of the higher hills, certainly on Henderson's or Moreland's hill, both of which rise so high. That they seem to be almost equal to Laurel hill, though in reality they are about 600 feet lower. The lack of exposures, however, is so complete, that no definite determination could be made. Along Possum creek, which enters the river opposite Connellsville, there are no exposures for three miles, everything being buried under a deep cover of terrace detritus. Where the road turns off to New Alexandria, a dark blue limestone is seen underly-

ing some black shale, on which rests a thick sandstone. Ascending Moreland's hill here, a coal bed 2 inches thick is seen at 120 feet above the limestone; another blossom occurs at 150 feet, and at 190 feet is a third. In the intervals between these coals, there seems to be only shale and sandstone. The synclinal axis evidently crosses near where this road leaves the creek, for on the north side of the hill the rocks are clearly rising northwest.

Between Possum creek and the Uniontown and Connellsville road, several high hills catch a small coal, probably the *Washington*, which was once opened on Mr. Walker's property, where it is said to be 4 feet thick. A coal bed, probably the same, is exposed in the Uniontown road near its junction with that leading to Dunbar. Along this road, which for the most part follows a high ridge, the exposures are poor. Near Mt. Braddock the blossom of a coal bed is seen, which is in two layers, separated by a thick clay, in all perhaps 4 feet thick. Over it is a dark shale, containing thin layers of a slightly carbonaceous ore, above which is shale. This may be the *Waynesburg a*, or possibly the *Waynesburg*. The exposures in the vicinity are not such as to aid in determining the relations of the bed.

Along the railroad, which follows quite closely the eastern outcrop of the *Pittsburg coal bed*, exposures of that bed are numerous. At the summit on the township line between Frosts station and Mt. Braddock, the lower division of the Great Limestone is shown as follows:

1. Reddish shale,	6'	} 66'
2. Limestone,	15'	
3. Dark shale, with thin sandstone,	10'	
4. Limestone,	8'	
5. Clay,	1'	
6. Limestone,	18'	
7. Shale,	10'	

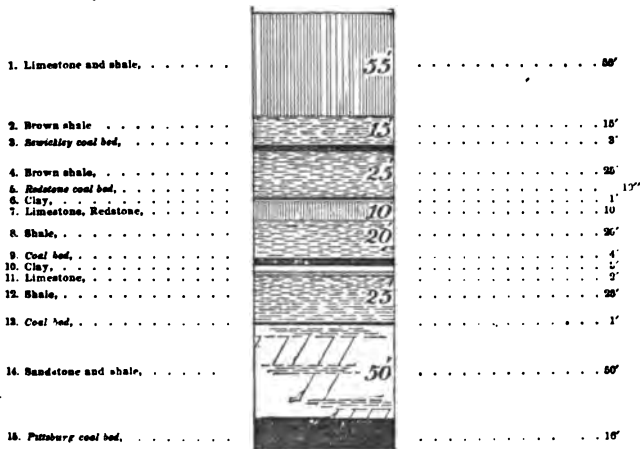
No. 2 is quite siliceous and some of the layers are conglomerate. No. 4 is in several layers, varies from blue to red and is more or less argillaceous throughout. All of its layers contain fossils, which are very minute and are replaced by calspar, so that the freshly fractured surface has a birdseye appearance. No. 6 is a variable mass, some

of the layers being pure enough for use as flux in the furnace, while others are almost a compact calcareous clay. The upper portion for about 6 feet is evidently a cement rock. At one time the *Sewickley coal bed* was mined near this cut.

At Braddocks station the *Pittsburg coal* is mined for coking. At about 35 feet above it there is exposed in the railroad cut a coal bed 1 foot thick with 4 inches of black shale resting on it. Underlying it is a carbonaceous shale, 2 feet thick, containing many streaks of coal, from one twentieth to one tenth of an inch thick. This coal is seen at a short distance north in a lane leading to Mr. W. Beeson's residence, and at 30 feet above it is a thick bed of coal, imperfectly exposed, and overlaid by shale containing about midway 10 inches of slaty coal. The Redstone Limestone is shown above with the *Redstone coal bed* resting on it, while at a short distance higher is the *Sewickley*, the Fishpot Limestone being exposed below it.

Back from Ferguson's station the *Pittsburg* is mined by Hoggsett, Bell & Co., and on the adjoining or Hill farm it is mined by the Dunbar furnace company. On the latter property the limestones above the coal are quarried for use as flux, and the following section is exposed:

Fig. 20.



Upper Coals at Dunbar.

No. 1 is a variable mass of limestone and shale, evidently the same with that seen on the railroad south from Brad-docks station. Many of the layers are very good while others are so argillaceous as to be worthless for fluxing purposes. The *Sewickley coal bed* is exposed only by blossom, but it is said to be double and about 3 to 4 feet thick. The *Redstone coal bed* is well exposed in a quarry where the limestone, No. 7, is taken out for use at the furnace. Both the coal and the limestone resemble the same strata at Le-mont. No. 9 is not exposed directly in the line of the sec-tion, but it was seen in the road leading from the coal mine to the limestone quarries, associated with a thin limestone. No. 13 is exposed in the same road. The *Pittsburg coal bed* shows a roof in ten layers, six of them coal, aggregat-ing 3 feet 7 inches, the total thickness being 5 feet 1 inch. It is separated by one foot of clay from the lower division, which varies from 9 to 10 feet. This portion of the bed is much troubled by swells of the underclay, which sometimes cut out the coal up to the bearing-in, or nearly 5 feet. These frequently extend many yards horizontally and are a source of much annoyance and loss.

On the adjoining property the same coal is mined by Messrs. Paull, Brown and Company. In a pump shaft, No. 9 of the last section, was found at 75 feet above the *Pitts-burg*, but No. 13 is not reported. In the mine belonging to this firm, the roof division is not reached, and the lower division is not fully exposed. The thickness is given on authority of the pit-boss. The section is:

Coal, 7 feet to 7 feet 6 inches ; *coal* and partings, 3 inches ; *coal*, 3 feet.

As on the Dunbar property, the under clay swells so as to cause serious trouble, often cutting away from two to four feet. In quality the coal is excellent and is largely mined for coking. These two mines are very handsomely opened. Almost adjoining the last are Mr. Henderson's coke-works, and directly north from those are the mines belonging to Mr. Watt. Beyond these and near the river are the Connellsville coal and coke-works. In all of these the section is practically the same as that just given.

At Braddock's station, and on both the Hill and Paull farms, the ores of the Pittsburg Group have been found. No search for them seems to have been made on the property of Hoggsett, Bell & Co., but they are undoubtedly there. On the Dunbar property where they are mined the section is as follows :

1. <i>Pittsburg coal bed,</i>	—
2. Clay,	2'
3. Ore,	11"
4. Black clay,	3"
5. Ore,	3" to 4"
6. Bituminous shale,	1'
7. Clay with flag ore,	1'
8. Clay with lump ore,	3"
9. Bituminous shale,	1' 2"
10. Flag ore,	1"
11. Not exposed,	16'
12. Limestone,	20'

The ores, 3 and 5 are the ones mined. At one time they were taken out on the Paull farm where the upper layer is said to occur in the horseback, maintaining always about the same distance from the coal. This, however, is not the case on the Dunbar property, where, according to Mr. McClavy's statement, the ore does not follow the swells in the clay. For a distance of 500 feet under the hill this ore is simply a brown mud, and in appearance as unpromising material as one is likely to find. Further in, it becomes compact and somewhat lighter in color; but the compact ore is said to be leaner than the mud, which, notwithstanding its unpromising appearance, averages nearly 27 per cent. of metallic iron. It is said to be reduced with great ease.

No. 6 is a rich bituminous shale, with a cannel-like fracture, and burns readily, though it leaves a bulky ash. No. 7 is a compact clay shale, with little carbon, and contains several layers of flag ore from one fourth to one inch thick. On exposure to the atmosphere it breaks down and the ore is separated. As the ore is quite good it might be collected without serious cost, the total thickness being not less than two inches.

Directly underlying this is a layer of clay, containing an irregular lump ore, which is believed to be the Blue Lump

of the Oliphant section. It frequently contains stems of plants, and a fine stem of *Calamites* replaced by this ore is exhibited in the office of the pit-boss. The flag at the base varies from one to nine inches in thickness, and is so irregular both in quantity and quality that it is not mined. No ores have been found in No. 11, which is said to contain only shale.

On the Paull property these ores were mined and shipped to Dunbar furnace when it was under a former management. The section on the southern portion of the estate is similar to that on the Hill farm, but toward the northern part it changes; on the Henderson land there is hardly a trace of ore, and on the Watt property the whole series has disappeared. No evidence of their presence has been found at any locality further north in this township.

On Dunbar creek, from the furnace office to Watts station, the Lower Barren Series is quite fully exposed, and the section, as there obtained, is as follows:

1. <i>Pittsburg coal bed</i> ,	—
2. Concealed,	15'
3. Sandstone,	10'
4. <i>Coal bed</i> ,	6'
5. Clay,	3'
6. Limestone and shale,	20'
7. Connellsville sandstone,	60
8. Shale,	50'
9. Limestone,	5'
10. Shale,	5'
11. Morgantown sandstone,	55'
12. Sandy shale,	12'
13. <i>Coal bed</i> ,	1'
14. Shale,	12'
15. Concealed,	12'
16. Variegated shale and clay,	35'
17. <i>Coal and clay</i> ,	2'
18. Dull brown shale,	0' to 20'
19. Sandstone,	15' to 40'
20. Shale,	45'
21. <i>Coal bed</i> ,	2'
22. Shale,	63'
23. Limestone,	8'
24. Shale,	7'
25. Argillaceous sandstone,	10'
26. Imperfectly exposed,	25'
27. <i>Coal bed</i> ,	2'

28. Clay,	30'
29. Upper Mahoning sandstone,	35'
30. Coal bed,	2'
31. Fireclay,	4'
32. Lower Mahoning sandstone,	35'
33. Upper Freeport coal bed,	—

No. 4 is exposed for several hundred feet along the road leading northward from Henderson's coke-works, and it was seen in part on the hill farm of the Dunbar property. The limestone, No. 6, was observed at both localities, and has been quarried. Fragments of it occur in the roads, but the exposures are not such as to give any definite idea respecting its thickness. No. 7 comes in sight along the railroad, just below Henderson's coke works, where it forms an imposing bluff, which continues in view all the way to the Youghiogheny river. On the Hill farm, its place is occupied by shales containing barely 6 feet of sandstone. Below Dunbar, much of it is massive, and the rock is extensively quarried. The lower half seems to be the more persistent as sandstone, for along the river below the mouth of Dunbar, the place of the upper half is filled with shale, more or less arenaceous, while the rest is a good sandstone and is quarried near Connellsville. As exposed along the railroad, this rock varies from fine-grained to coarse, and from compact to shaly. Its lower layers contain many casts of plant-stems.

No. 8 is a mass of dull shale. The limestone, No. 9, was not found in place, but its fragments were seen in quantity near Watts station, and on a hill on the east side of the railroad. The thickness given was reported to me.

No. 11, the Morgantown Sandstone, comes down to the creek, directly opposite the depot at Dunbar station, and forms a well-marked cliff from that point to where the South-West Pennsylvania railroad crosses the creek. It goes under very near the junction of Henderson's siding with the railroad. The upper portion is much cross-bedded, but is harder than the middle, which is cross-bedded and so irregular in composition as to have a honeycombed surface. The bottom is more or less shaly, and passes imperceptibly into the next rock below. At about ten feet from the base

is an indefinite layer, 15 to 20 inches thick, which holds ferruginous concretions, some of which weigh more than half a ton. No. 12 contains an iron ore, of which a sample, analyzed by Mr. Wuth, showed 24 per cent. of metallic iron, with an equal percentage of silica. This ore is well exposed on the road leading from Dunbar station to Paull, Brown & Co.'s coke-works.

No. 13 was seen only on the same road. It shows an inch of clay about midway, and is apparently a good coal. The underlying shale is somewhat arenaceous. No. 15 is very imperfectly exposed, but seems to be a continuation of the variegated shale below. The Green or Crinoidal limestone should be present at the base of No. 16, but it is absent on this road, though it is said to have been found in a neighboring field. No. 17 was seen only where this road reaches the creek, and there the exposure is too imperfect to permit one to make positive determination respecting the character of the rock. In position it is equivalent to the *coal bed VII b* of Ohio. The dull brown shale No. 18, was found only where this road crosses the railroad, and there it suddenly replaces the sandstone, No. 19, but in a few yards disappears as suddenly as it appeared. It is without lamination and is only a dull brown clay, with occasional nodules of iron ore and limestone.

No. 19 first comes up from under the track just below Fergusons station, where it is quarried by the South-West Pennsylvania railroad for use as ballast. It varies from fine grained to coarsely conglomerate, the white quartz pebbles being larger than a pea; and much iron oxide is distributed throughout the rock. At the southern end of the cut the mass is about 35 feet thick, but within a few rods it thins out abruptly, and its lower half is occupied by a dull colored clay. This sandstone is well exposed on both sides of Dunbar creek, at the railroad crossing above the village, has been quarried near the Dunbar company's tramway west from Gists run, and has been slightly quarried on the opposite hill alongside of the creek, where huge blocks of it lie scattered over the hillside. At some of the exposures here it is cross-bedded and irregular throughout,

while at others its upper portion is a handsome rock, occurring in layers 4 to 8 feet thick, and splitting so as to make a very fine building stone. This portion is comparatively fine grained, but many times the rock is so coarse that large fragments, such as those lying near the track at half a mile below Ferguson's station, might readily be mistaken for transported fragments of the Pottsville Conglomerate. So closely allied is it in composition to that Conglomerate, that one can hardly resist the conclusion that its material has been derived from that rock. This stratum appears to occur in great lenticular masses amid the variegated shales. At the cut below Ferguson's it is badly cut away underneath, and at Dunbar it is similarly cut away to make room for shale above; the shale above and below being the same at both places. The excellence of this rock as a sandstone is therefore purely local.

No 20 is well exposed as a mass of shale and clay, on Dunbar creek, at a short distance from the railroad. It is in part exposed on the railroad in the cut below Ferguson's, to which reference has already been made. No. 21 is no longer exposed at any locality visited. Some years it was opened in the bluff alongside the road leading up Dunbar creek to the furnace, but proved too insignificant to repay working. The overlying shale is laminated, black, and cut by cleavage planes; while that below the coal is variegated, and in large part shows no lamination. The limestone, No. 24, was observed only in the bluff back of the carpenter's shop, say, one half of a mile below the furnace company's office, where it is quite ferruginous and weathers to a bright buff color. No. 28 was mined some years ago about one fourth of a mile below the furnace office, but the opening has become so choked that no measurement can be made, and the thickness is given upon information. The same bed is imperfectly exposed on Gists run, opposite the firebrick-works, but only the upper portion is shown, and that is badly cut by vertical fissures filled with vertically laminated shale. The underlying clay shows no bedding and contains many nodules of iron ore. With these are associated great numbers of nodular pieces

of fireclay coated with ore, and the mass has been mistaken for a rich ore-deposit. This clay is at the horizon of the Johnstown Ore, but that does not seem to have been discovered at any locality in this vicinity.

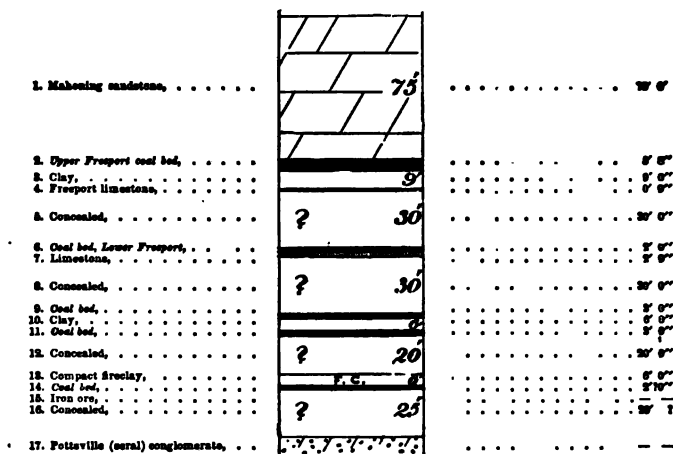
Nos. 30 to 33 inclusive, are the Mahoning Sandstone and are well exposed behind and below the furnace company's office. The coal bed is double, showing:

Coal, 1 foot ; *clay*, 3 inches ; *coal*, 10 inches.

A rude opening in this bed was seen back of a little house below the company's office.

The Lower Productive Coal Series are exposed along Dunbar creek above the furnace, dipping sharply toward the north-west. An approximate section is as follows :*

Fig. 21.



Lower Coals on Dunbar Creek.

The *Upper Freeport coal bed* has been opened on both sides of the creek near the office, but it is no longer mined, owing to the inferior quality of the coal. The opening on the south side shows the following structure :

Coal, 4 feet 7 inches ; *clay*, 1 to 2 inches ; *coal*, 1 foot.

At a distance of perhaps 100 yards from the mouth of the pit, a fall in the roof exposes another bed or rather another portion of this bed, 2 feet thick, and separated from the

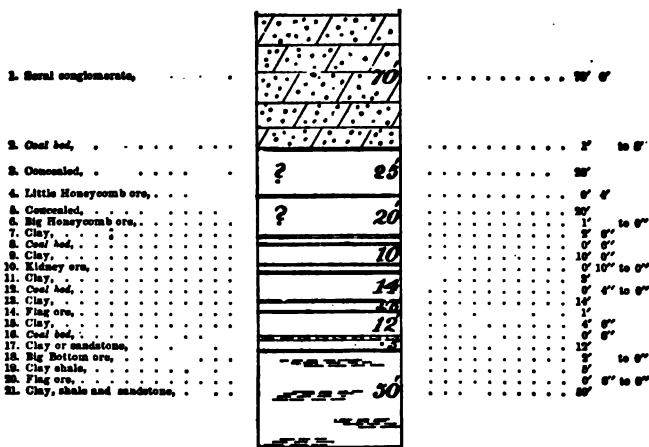
* This section was not measured, and the intervals are those given to me.

rest by 3 feet of slickensided clay. How far this portion of the bed extends is not known, but it certainly does not reach to the outcrop, for its place is shown on both sides of the creek and the coal is absent.

The Freeport Limestone is principally iron ore, there being only 2 inches of limestone. The ore is apparently quite good. Whether it will prove persistent as an ore is doubtful, if one may judge from the experience of those who have tried it in the southern townships. The coal bed No. 6 was seen near the ore kiln, and its limestone is exposed at the same place. The latter is coarse and in part brecciated. The lower coals are no longer worked, and the thicknesses are given according to the statement of Mr. McClavy, the mining superintendent. The compact fireclay No. 13, is the same with that already noticed in the townships further south, and seems to be persistent along the face of the mountain.

At somewhat less than half a mile above the furnace, the Conglomerate is shown in the bank of the stream and at about a mile further, the first of the ore mines is reached. The section from the conglomerate seems to be :

Fig. 22.



Umbrai Ores at Dunbar.

The showing of ore in the section is very great, aggregating

between four and five feet, but unfortunately all of the layers are very irregular in their thickness.

No coal bed has been found directly associated with the Little Honeycomb, and only one occurs with the Big Honeycomb. The other coal beds are the same with those of the North Union section.

All of these ores disappear in coming down the mountain at about a mile and a quarter from the furnace. There on Hennessey hill, are the three main mines on the Big Honeycomb, in all of which the ore is a plate, having the honeycomb structure of the ordinary kidney ores of the coal measures. It is excessively irregular, and is often cut out for many yards. In the main heading of mine No. 1, these "misses" are so numerous and the ore when present varies so greatly, that the layer seems to be utterly worthless. The extremes of its thickness are zero and 6 inches, but its quality is very fine. In mines No. 2 and 3 the conditions are the same, and in No. 3 the ore is somewhat siliceous. Notwithstanding all these irregularities, the little coal bed below affords so good a bearing-in that the miners dig this ore at the same price with that charged for the much thicker Big Bottom ore. In all these mines the roof is properly a sandstone, separated from the ore by about 2 feet of clay; but at a considerable distance in, this is suddenly replaced by a structureless clay, which makes a very insecure roof. Under this clay roof the ore is much more uncertain than under the sandstone. Below the coal bed there is a fine potters' clay. At this locality the other ores seem to be wanting.

The Kidney is an extremely irregular ore, and at most points on this property is not worked; but at an opening recently made, it has been found fully ten inches thick and of superior quality. In color it closely resembles the Big Honeycomb ore of North Union, and like it is a compact layer. The Flag ore is of no value. On the out-crop it seems to be very good, but in every instance, where it has been followed to any distance under cover, it has lost its ferruginous character and has been replaced by sandstone.

On Irishtown hill, the Big Bottom has been mined for a

number of years, and the openings are sufficiently extensive to justify positive conclusions respecting the persistence of the ore. Mine No. 1 is 2,500 feet long in the main heading, and in No. 5, somewhat higher up in the hill, the main heading has been driven wholly through the hill, a distance of 2,100 feet. The intervening mines are not so long. The rocks associated with this ore vary, but the following is the normal section:

1. Fire clay,	8'
2. Blue shale,	4'
3. Ore and clay,	1' 8"
4. Blue shale,	5'
5. Sandstone and clay,	—

So long as Nos. 2 and 4 retain the thickness given in the section, the ore is certain to be in large quantity, but when No. 2 becomes thin, the miner expects before long to find a horseback of No. 1 coming down to cut out the ore. Occasionally a horseback of red shale is thrust up from below, which necessarily displaces the underlying sandstone before it can reach the ore. The troublesome horsebacks are those of No. 1, and consist of a structureless clay, with extensive slickensided crevices, which are filled with a ferruginous mud. On each side of these the ore thickens up abruptly.

When pure, this ore is never found in less than two layers, though occasionally the intervening clay becomes very thin. At some places these layers have been found almost seven feet apart, but within a few yards in each direction they come close together. An extreme case of subdivision in this ore is the following, seen in mine No. 1:

1. Ore,	6" to 7"	} 3' 4"
2. Clay,	6"	
3. Ore,	4 "	
4. Clay,	6"	
5. Ore,	5" to 7"	
6. Clay,	6"	
7. Ore,	6"	

In Big Bottom mine No. 2, the following measurement was made at 2,000 feet from the out-crop:

1. Blue shale,	—	} 3' 3"
2. Ore,	10"	
3. Clay,	8"	
4. Ore,	4"	
5. Clay,	1' 8"	
6. Ore,	8"	

In an adjoining room the clays 3 and 5 have almost disappeared, and the ore, with the thin partings, measures 2 feet 5 inches, but this is simply an illustration of the abrupt thickening in front of a horseback, for, in the second room beyond, only the bottom layer is seen, the others having been cut out by the clay.

This ore seems to be especially troubled. Sometimes it breaks up into kidney-like lumps, which are not too closely packed. In several of the openings, it shows an abrupt change in composition. As has been shown in another part of this report, the ore is a carbonate of exceptional purity, usually containing only a minute proportion of phosphorus. In mine No. 1, it is suddenly changed into a coarse siliceous material carrying much manganese, with a diminished proportion of iron, and one and one half per cent. of phosphorus. A similar change has been observed in other mines. This worthless ore displaces the other, and occurs in a single layer, about one foot thick. The variation in character takes place within a few feet, and without warning. The changed ore may possibly lie in a continuous band, but its mode of occurrence in the several mines is such that it is more likely to be in irregular patches.

In the gap of the Youghiogeny river the lower Umbral and the underlying rocks are imperfectly shown, so that no definite section could be made out. The thickness of rock between the river and the Umbral Limestone at the hill top cannot be less than 1,200 feet, and at the crest of the arch it may be more. The rocks are merely sandstones and reddish to reddish-gray shales, no traces of any limestones having been observed anywhere in the gap under that of the Umbral.

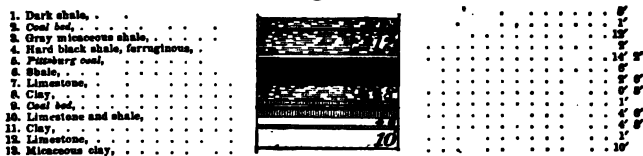
6. CONNELLSVILLE TOWNSHIP, OF FAYETTE COUNTY.

This lies north from Dunbar, and has the Youghiogeny river for its southern boundary. At the east it reaches to

the top of Chestnut hill, the same ridge, which south from the river is known as Laurel hill. The axis of this anticlinal crosses the river at somewhat less than a mile and a half west from Indian Creek station, and the axis of the Blairsville synclinal crosses the river near the shaft above Broadford. The section extends from about 400 feet above the *Pittsburg coal bed* to the Catskill rocks, but above the *Pittsburg bed* the exposures are few and unsatisfactory. That bed comes up from the river just below Connellsville and its outcrop, after curving round through the city, lies east from the Connellsville and Mt. Pleasant road to the township line. A small anticlinal, already referred to in another chapter, brings up the coal for a short distance along the river and Mounts creek below Connellsville.

Along the several railroads the *Pittsburg coal bed* is mined extensively for coking. The details respecting this industry are given so fully in the coke report that no reference is necessary here and only one section is given to show the structure of the bed. The following was obtained on the river bank just below Connellsville :

Fig. 23.



Section at Connellsville.

The *Pittsburg coal* shows :

Roof division, 5 feet 1 inch ; main clay, 1 foot ; lower division, 8 feet 1 inch.

The roof is in six layers, and contains 3 feet 7 inches of coal, including 10 inches of bituminous shale on top. The lower division is in four benches, 45, 26, 4, and 20 inches thick, with partings one half to one inch. No. 6 of the section holds the place of the Pittsburg ores, but these are wholly wanting here, or rather are represented only by a few lamellar plates, barely one tenth of an inch thick. At one point this space shows lenticular masses of limestone, several feet long. No. 12 passes imperceptibly into No. 13,

which is a coarse fire clay, light colored, and very micaceous. The Connellsville Sandstone, at about 80 feet below the coal, is quarried near the depot of the South-West Pennsylvania railroad. Iron ore is reported to occur below the coal at several mines in this township, but in no case is the quantity regarded as of economic importance.

Almost midway between White Rock station and the sandworks, Mr. Swank has opened a coal bed, at a little distance north-east from the township road. The section exposed is as follows:

1. Shale,	10'	} 7' 2"
2. Coal,	0' 2"	
3. Shale,	1'	
4. Coal,	6'	

No. 4 is in four benches, 41, 9, 9, and 10 inches thick, separated by partings of bony coal, each 1 inch. It rests on a black shale, and there is probably another bench below. The partings, including No. 3, contain impressions of *Stigmara*, and impressions of other plants occur in No. 1, which is a dark shale, with some carbonaceous layers. The coal from this bed is very pure, and produces an excellent coke. Some have thought it to be the *Pittsburg*, but a little examination will show at once that this identification is incorrect. The eastern out-crop of that bed is at Connellsville, nearly a mile and a half below this point, and there the bed is rising eastward at fully three degrees. No anticlinal occurs between Connellsville and the Swank bank, so that there is no possible way by which the *Pittsburg* coal could come down to the place of that pit. But irrespective of this, the bed itself shows features which at once prove it to be the *Upper Freeport*, and not the *Pittsburg*. It lies very near the Mahoning Sandstone, which contains layers of conglomerate, thereby differing from the *Pittsburg* Sandstone. The partings contain impressions of *Stigmara*, which never occur in the partings of the *Pittsburg*, while below this bed the rocks of the unquestioned Lower Coal Series are seen in a little hollow leading to the river. Where the exposures are bad, and the coal is very thick, the *Upper Freeport* bed is liable to be mistaken for the *Pittsburg*, especially if the dips be sharp,

for a limestone, the Freeport, occurs below it at about the same distance as does the one below the *Pittsburg*, while above it is a limestone, holding nearly the same relation to it that the *Redstone Limestone* does to the *Pittsburg*. Both of these limestones are here, and this association, together with the extraordinary thickness and excellence of the bed, has led to the firm belief that this is the *Pittsburg*.

In a hollow, leading from this bank to the river, a coal bed, said to be 4 feet thick, was once rudely opened; but the pit has fallen shut, and no information can be obtained respecting the bed. On the railroad, two thin coals, holding a still lower place, were seen, but their relations were not accurately determined.

At the sand-works, about two miles above Connelleville, Messrs. Speer, Clark & Co. crush a sandstone to prepare glass-sand. This rock is 30 feet thick, and its base is 130 feet above the bottom of the Conglomerate, which is about 80 feet thick, so that the upper stratum is probably the Piedmont (?) Sandstone. Its quality is quite variable, some portions yielding a fine white sand, while others are so ferruginous that the sand is fit only for very coarse work. The stone is broken in a crusher, then ground by heavy rollers, screened, and carefully washed three times to remove the clay, of which there is a considerable quantity distributed throughout the stratum.

The section of the lower coals cannot well be made out from the exposures, which are widely separated, and owing to the variation of the dip, they cannot be joined without close instrumental measurement and careful calculation. The Pottsville (Seral) Conglomerate, as shown in the gap of the Youghioghenny river, is not a conglomerate but a fine-grained sandstone, as is commonly the case on the west side of Chestnut hill within this district. It is well exposed on the hillside above the sand-works, and in a railroad cut the Umbral ores were once worked, under it back of the sandworks; but the mines are now closed and no satisfactory information can be obtained respecting them. As far as could be ascertained, the series in all respects closely resembles that exhibited at the Dunbar property.

At a short distance above the sand-works, the Umbral Limestone is seen. The upper or fossiliferous portion seems to be little more than 10 feet, but the whole of it may not be exposed. It is separated from the lower portion by about 15 feet of shale, part of which is calcareous. The lower division is siliceous, light blue, very brittle and breaks with a conchoidal fracture. The amount of calcium carbonate present is very small and it is easily removed on exposure so that the rock becomes a loose-grained, friable sandstone, which may be reduced to sand simply by rubbing between the fingers. This rock, which is about 40 feet thick in all, is quarried here to be used as paving stone in Pittsburg.

Above this along the river the exposures are very incomplete. The Vespertine or Pocono Sandstone comes in at once under the limestone and, rising rapidly to the axis, soon forms cliffs on the mountain side. Many of its layers are distinctly conglomerate. Below it are red shales and shaly sandstones to the axis, which crosses the river somewhat less than one mile and one half below Indian creek.

7. BULLSKIN TOWNSHIP, OF FAYETTE COUNTY.

This, lying directly north from Connellsville, is the north-east township of the county, along the west face of Chestnut hill. The section extends from nearly 200 feet above the *Pittsburg coal bed* to the lower Vespertine rocks. A slight anticlinal fold crosses the township in a direction rudely parallel to the mountain, and is sufficiently strong to throw the out-crop of the *Pittsburg bed* to the east of Mounts creek.

The eastern out-crop of the *Pittsburg bed* lies within this township, from the vicinity of Jacobs creek to the line of Connellsville township. It begins on the Connellsville and Mount Pleasant road, about one mile from Jacobs creek, at the coke works. From this point the extreme out-crop lies east from that road to a little beyond the first cross-road, when it crosses to the west. Thence it and the road diverge very gradually to half a mile south from Pennsville, after which they converge, and, when the road strikes Mounts creek,

the coal is in the hill alongside of the stream, and the Con-
nellsville Sandstone is exposed in the cut made for a siding.
Near this, on the east side of the creek is a small area of
the coal, in which the dip of the bed is reversed owing to
the little anticlinal already referred to. The Southwest
Pennsylvania railroad runs along the eastern out-crop, and
the coal is extensively mined for coking. This interest has
been fully described in the coke report and the bed has
been measured at nearly every opening, so that a single
section to show the character of the bed is all that is neces-
sary here. On a road coming down to the railroad, at about
half a mile south from Peunsville an opening shows :

1. Roof division,	4' 3"	} 12' 11"
2. Main clay partings,	8"	
3. Lower division,	8"	

The roof shows three benches containing 3 feet 7 inches
of coal, but the upper one, 2 feet thick, is almost equally
coal and shale. The lower division shows a bench on top,
5 feet 6 inches, without a break or even a binder. This
feature was seen in several openings, but in many others
the slates are quite numerous.

Near the head of Mounts creek stood the old Vernon fur-
nace, one of the earliest erected along the face of the
mountain. It depended wholly on the Umbral Ore. The
property now belongs to the Charlotte furnace company, by
whom the ores are mined. The section at the mines is as
follows :

1. Ore,	4"
2. Concealed,	15'
3. Pottsville (Seral) Conglomerate,	60'
4. Coal bed,	3" to 6"
5. Sandstone,	3'
6. Clay,	1' 6" to 3"
7. Pin Ore Bed,	3" to 0"
8. Clay,	2' 6"
9. Big Bottom Ore Bed,	1' 2" to 0"
10. Clay,	3'
11. Ore Bed,	2"

The ore overlying the Conglomerate and separated from
it by shale or clay, was seen along side of the tramway,
just below the company's store. It lies near the surface
all the way up the hill, and can be mined only by stripping.

It was thus obtained for the old furnace, and the benching extends far up on the hill side. This belongs to the Mt. Savage (?) group of ores, but, so far as I could ascertain, that coal bed has never been found. None of the higher coals can be identified. A bed, 4 feet thick, has been opened near the crest of the hill opposite the mines, but its relations were not satisfactorily determined.

The Conglomerate is in three divisions, the middle one being 35 feet thick. It is said to be separated from the upper one by two or three feet of shale, which contains a thin layer of iron ore, but this shale was not exposed at any point examined. The little coal bed between the middle and lower division is quite frequently seen near the mouths of the ore pits, where the rock is decayed and the roof of the entries falls, but further in it is rarely exposed. It seems to be fully persistent in this vicinity.

The Pin ore of these mines is either the Kidney ore of other localities, or it is a subordinate division of the Big Bottom. The variations of that deposit, as shown at the mines described in other townships, are such that the latter supposition may easily be regarded as true. This Pin ore is a layer of nodules which is far from being constant or regular, though it has been found in every drift yet opened. The nodules are lenticular, and in their shorter diameter are from 2 to 6 inches thick, the average being not far from 3 inches. The quality is excellent. The Big Bottom has the same characteristics here as elsewhere. It is of dull brown color and occurs in two layers, as follows :

Ore, 4 to 8 inches ; clay, 3 inches ; ore, 7 to 8 inches.

Ordinarily the variation in the layers is such that the total thickness of ore is not far from one foot. As at other localities, the deposit is much disturbed by horsebacks which displace it for several yards. On each side of these the ore suddenly thickens up, and some of the diggers think that the horsebacks cause no loss. This seems hardly possible, and in the case of some horsebacks seen by me it is not true. At the same time this impression on the part of the diggers, who mine the ore by contract at a fixed price per ton, shows that the loss by these "misses" is not ex-

treme. The disturbing agent is the clay, No. 8, and the Pin ore is not affected. It, however, has its own troubles and is frequently cut out for many yards.

For the old furnace these ores were mined by benching only, as the blast used in the charcoal furnaces of the older times was not sufficient to reduce any but crop ores. The present workings are little more than a year old, and the longest entry extends 550 feet.

The same series of ores was mined for the old Breakneck furnace on Breakneck creek, two or three miles further south, but the mines have not been worked for a long time, and no direct information can be obtained respecting them. On the same creek, a coal bed 4 feet thick was once worked. It is probably the *Upper Freeport*, but no exposures were found in the vicinity to aid in determining its relations.

Along Mounts creek, below the mines, there are no exposures, and the lower coals do not seem to have been seen by any person. The coating of debris is certainly very thick where these coals should be found. In all the deeper hollows along the face of the mountain, the Umbral limestone is reached. It shows characters the same with those already referred to in the description of townships further south.

8. TYRONE TOWNSHIP OF FAYETTE COUNTY.

This lies along the Youghiogheny river and the county line between Bullskin and Perry townships. It is crossed by the Saltsburg anticlinal, which enters it near the old furnace on Jacobs creek and leaves it on the Youghiogheny at about two miles above Layton station. The section extends from somewhat more than 200 feet above the *Pittsburg coal bed* and the *Lower Freeport (?) coal bed*. The western outcrop of the *Pittsburg bed*, in the Blairsville trough, passes through the township.

Along the road leading from Dawson station to Mt. Pleasant, the *Pittsburg* is mined by Messrs Cochran & Kiester for coking. At their opening it shows :

Roof division, 5 feet ; main clay, 8 inches ; lower division, 9 feet.

The roof is in seven layers, and contains in all 3 feet 8

inches of coal, including the 8 inches of bituminous shale on top. The layers are irregular in thickness, especially on top, where the coal and shale dovetail. At the base are two layers of coal, each 14 inches thick, which seem to be of very fair quality. Of the lower division only 7 feet 6 inches are exposed at the mouth of the pit, and, of this, 18 inches are left in the mine to support the roof. At a little distance further up the hollow the same bed is mined by Mr. J. Cochran, at whose openings it shows a similar section. The coal is of excellent quality here, and makes as good coke as that from the eastern out-crop. These two firms, have, in all, somewhat more than four hundred beehive ovens. On the road from Dawson station, the coal is first seen at about half a mile from the river.

On the road to Kiester's mill the coal is seen on Mr. Newcomer's property, at a little way beyond the school-house, but the lower division only is exposed, showing a total of 8 feet 6 inches. It has six benches, 43, 10, 14, 14, 6, and 12 inches, separated by thin partings, all of them less than one inch thick. From this point to the first fork south from the Tyrone Presbyterian church, this road and the out-crop of the coal are nearly parallel, the latter being somewhat less than one fourth of a mile west from the former. Opposite the church the line of out-crop swings off somewhat to the west, and the coal is caught in a high knob west from the church. Thence the lines diverge as the road turns toward the north-east, while the out-crop line continues almost north to within a short distance of Jacobs creek. On the road, the *Sewickley* is mined by Mr. J. Strickler, who has it nearly 6 feet thick and of good quality for domestic use. The *Pittsburg* is again reached near Keister's mill.

On the road leading from the mill to Broadford, the following measurement was made at an opening belonging to Mr. Kiester:

1. Shale,	4'
2. Sandstone,	2'
3. Shale,	3'
4. Roof division,	3' 4"
5. Main clay parting,	6"
6. Lower division,	8' 2"

The roof is in five layers, and shows in all 2 feet 8 inches of coal. The upper part of the lower division is rather slaty for 2 feet, and is not mined. Nearly midway are two thin partings, three inches apart, between which is the bearing-in bench.

Half a mile further south on this road, the Mt. Pleasant branch of the Pittsburgh and Connellsville railroad is reached. Along this the *Pittsburg coal bed* is available quite to Broadford, and is mined by many firms for coking. This line has been so fully reported on in the coke report, that no further reference to it is necessary here.

Along the Youghiogheny river the *Pittsburg coal* is mined above Broadford, and at the Jackson mines shows:

Roof division,	5'	} 15' 6"
Main clay,	10"	
Lower division,	9' 8"	

The roof division contains 2 feet 8 inches of coal, not including 4 inches of bituminous shale on top of the bed. The section below the coal as exposed along the railroad, within half a mile below the Jackson mines, is:

1. Clay,	2'
2. Limestone and clay,	8'
3. Dark shale,	1' 6"
4. Coal bed,	8"
5. Shale,	2' to 0"
6. Sandstone,	5'
7. Yellow shale,	12'

The little coal bed, No. 4, is not persistent. No. 7 is reached at the Keeler station. Between Broadford and the Jackson mines there is a well marked anticlinal, whose crest is nearly midway between the two points. At the end of the coke ovens attached to the Jackson mines, the coal is below the track of the railroad, but there it again begins to rise westward. From Keeler's station to within one fourth of a mile from Dawson station, there are no exposures, but there the following section in the Lower Barren Series was seen:

1. Sandstone,	12'
2. Shale,	5'
3. Limestone,	1'
4. Shale and clay,	15'
5. Coal bed,	Blossom.

6. Clay,	3'
7. Limestone,	1'
8. Calcareous clay,	3'

The interval between the top of this and the base of the last section, is not far from 90 feet. West from Dawson, exposures begin again, but the interval between the two points could not be determined. The section west from Dawson to the crest of the Saltsburg anticlinal is:

Fig. 24.

1. Laminated sandstone,	10	10'
2. Shale,	35	35'
3. Clay,	10	10'
4. Limestone,	1	1'
5. Clay,	3	3'
6. Limestone,	3	3'
7. Clay shale,	35	35'
8. Argillaceous shale, yellow,	13	13'
9. Sandstone,	7	7'
10. Sandy shale,	33	33'
11. Sandstone,	90	90'
12. Shale,	20	20'
13. Coal bed,	5	5'
14. Clay,	2	2'
15. Sandstone,	20	20'
16. Clays,	25	25'
17. Shale,	10	10'
18. Coal bed,	5	5'
19. Shale,	5	5'
20. Sandstone and concealed,	30	30'
21. Shale,	12	12'
22. Coal and shale,	5	5'
23. Clay,	10	10'
24. Mahoning sandstone,	45	45'
25. Upper Frappert coal bed,	2	2'
26. Clay,	12	12'
27. Concealed,	10	10'
28. Sandstone,	10	10'
29. Shale and sandstone,	30	30'
Total,		454'

Lower Barrens on Youghiogheny.

The portion from No. 1 to No. 11, inclusive, is exposed along the railroad from Dawson to Laurel station. No. 11 is first seen on both sides of the river, just below the latter place, rising toward the west with a rapid dip. Below that station, the upper part of the stratum for 40 feet has been freshly exposed, and is seen to be a yellowish-white rock in thick layers, rather soft, but doubtless a good building stone. This is crushed to prepare glass sand, as at the sand-works above Connellsville.

The portion between 11 and 18, inclusive, is exposed in the long cut, beginning at Laurel station and ending just below the forty-ninth mile-post. At the middle of this cut the whole mass to the bottom of 15 seems to be one great sandstone, with but a single thin shale parting; but toward the lower end of the cut Nos. 12, 13, and 14 come in. No. 15 prevails quite to the end of the cut, but there an abrupt change occurs, and it comes:

Sandstone, 12 feet; fire clay, 8 feet.

The sandstone is coarse, irregular, and at the base contains so many small pebbles of iron ore as to be a conglomerate. This rock appears like a foreign body as it lies across the plane of stratification. The whole appearance is as though, after the strata had assumed their present dip, an excavation had been made, into which this sandstone had been inserted. The fire-clay underneath is much crushed and shows many pyramids of various colors. No. 16 is a mass of clay and shale, dipping sharply toward the east, and having a total thickness of not less than 40 feet, though it occupies a space of only 25 feet in the section, as it is not conformable to the other rocks.

The thickness of the interval No. 20 cannot be definitely ascertained from exposures on the east side of the axis, but from the section at Layton, in Perry township, I am inclined to think it about 30 feet, and to regard the sandstone at the base as the same with that, which is there crushed to procure glass sand. Nos. 20 to 23, inclusive, are concealed on the east slope, but at a little way west from the crest they are exposed. The coal bed, No. 22, is poor material, and consists about equally of coal and shale.

Just before reaching the forty-eighth mile-post the *Upper Freeport coal bed* is seen under the Mahoning Sandstone, and shows :

Coal, 1 foot 6 inches to 2 feet 4 inches ; clay, 1 foot ; *coal*, 2 inches ; total, 2 feet 8 inches to 3 feet 6 inches.

No openings were found. At 25 feet below it is No. 29, which is a mass of shale or sandstone, sometimes altogether a sandstone, at others almost wholly a shale. The sandstone is more or less a conglomerate and contains badly preserved fragments of plants. This remains in sight to the crest of the axis, which crosses the river near the forty-seventh mile-post. The elevation of these rocks above the stream varies little from the point of their first appearance to the axis, owing to the course of the river which is but little off the strike.

Along Jacobs creek, the lower coals are reached under the arch of this axis. They are referred to under South Huntingdon township, of Westmoreland county.

9. PERRY TOWNSHIP, OF FAYETTE COUNTY.

This adjoins Tyrone and Franklin on the west and is divided by the Youghiogeny river. The section extends from the *Waynesburg coal* to the Mahoning Sandstone, and the township lies wholly within the Lisbon (Irwin) trough. The eastern outcrop of the *Pittsburg coal bed* passes through it in an almost north and south direction.

In the south-western portion the *Pittsburg* is mined along Stickle Hollow, beginning about a mile from the village of Perryopolis. At Mr. Lynch's opening it shows :

- | | | |
|------------------------------------|-------|----------|
| 1. Roof division, | 8' | } 10' 3" |
| 2. Main clay, | 0' 3" | |
| 3. Lower division, seen, | 7' | |

The roof is imperfectly exposed but seems to consist almost wholly of coal. The main clay is very hard and somewhat micaceous. The lower division is said to be 8 feet 9 inches thick, and consists of four benches, 30, 36, 3, and 36 inches. The partings are all very thin and that between the first and second benches is hardly persistent. The fourth bench shows no well-defined parting to distin-

guish the "brick" from the "lower bottom." The first bench is somewhat slaty, and is inferior to the others. The north-westward dip here is nearly 5 degrees, as determined by leveling from this opening to one opposite. From this point to the head of the hollow, openings were examined on both sides, and, where the road leaves the hollow to cross the divide to Crabapple creek, the coal is but a few feet below the surface. On the summit of the divide a limestone, probably the Fishpot, is exposed at 90 feet above the *Pittsburg* coal.

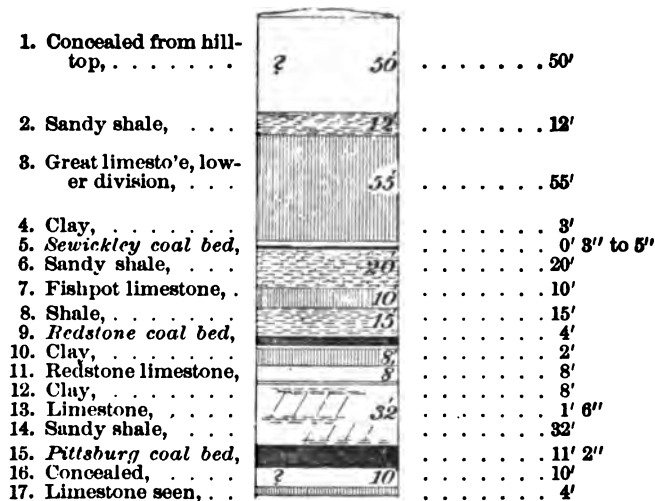
Descending on the other side to the waters of Crabapple, the bed is again seen at the opening belonging to Mr. Aaron Townsend, where it shows :

1. Clay shale,	8'	} 9' 4"
2. Roof division,	2'	
3. Main clay,	8"	
4. Lower division, seen,	6' 8"	

The "bearing-in" bench is at 5 feet from the clay and is 3 inches thick. The bed is not fully exposed, only 17 inches being seen below the "bearing-in." The coal is good and clean, in all respects resembling that obtained on Stickle hollow. Near this is another opening but it was not in condition to admit of measurement.

Along the river line the *Pittsburg* is worked at numerous openings for domestic use as far as a mile above the county line. At a little distance above the mouth of Jacobs creek and on the west side of the river a pit shows the roof division, 3 feet, and the lower, 8 feet 8 inches, the main clay being 1 foot. The roof contains two benches of coal, 12 and 14 inches, and is roofed by four inches of bituminous shale. At this opening, the four benches of the lower division are 74, 3, 12, and 10 inches thick, but there is a thin parting in the upper or breast bench at 15 inches from the bottom. On Brownellers run, which enters the river about a mile from the county line, the following section is exposed :

Fig. 25.



Upper Coals on Brownell's Run.

The Great Limestone shows its usual character, and is for the most part a dull-gray to dove-colored rock, quite brittle and yielding readily to the weather. None of the layers is fossiliferous. The *Sewickley coal bed* is little better than bituminous shale, and comes out in blocks; but where it has not been long exposed to the weather it is compact and looks like coal. The Fishpot Limestone is very poor and contains a good deal of iron. The shale overlying the *Redstone coal bed* is argillaceous at the top, but becomes somewhat sandy toward the base.

The *Redstone coal bed* has been opened at a short distance from the river, and is exposed also on the road leading northward from the run. At the opening referred to, it shows 4 feet 6 inches of coal near the mouth of the entry, one foot at the top being quite slaty and separated from the rest by 1 inch of carbonaceous clay or bony coal. At eight or ten feet in the entry, a horseback from the roof cuts out the top bench and a portion of the lower one, reducing the thickness to barely 3 feet. On the face the coal is irregularly laminated, but though thus crushed it is said to be a very good fuel, and for use in grates many prefer it to coal from

the *Pittsburg*, as it has less tendency to cake ; but its bulky ash renders it an inconvenient fuel in close stoves. The Redstone Limestone is highly ferruginous, but has been burned into lime for agricultural purposes. The sandy shale between this and the *Pittsburg coal bed* includes some layers of a yellowish gray, micaceous, flaggy sandstone, which contains much carbonized vegetable matter in minute fragments. At the mouth of the run there are several openings in the *Pittsburg*, which show :

Roof division,	2' 10"	} 11' 2"
Main clay,	1'	
Lower division,	7' 4"	

The roof has 6 inches of bituminous shale on top, and about 13 inches of coal. The lower division is in five benches, as at the last opening, but the top two belong to the upper bench making the section thus: Upper Bench, 5 feet 9 inches ; Bearing-in, 4 inches ; Brick, 5 inches ; Lower Bottom, 7 inches.

The whole of the lower division yields good coal, but 20 inches are left in the mine to support the roof, which is somewhat insecure. This upper portion contains more slate and sulphur than is found in the lower portion. The "Lower Bottom" is said to be quite clean, but is so soft that it cannot be mined with profit. About one third of a mile above the mouth of Brownellers run, an opening shows :

Roof division, 3 feet 6 inches ; main clay, 8 to 10 inches ; lower division, seen, 8 feet 4 inches.

The roof is in seven layers, and contains in all 2 feet 4 inches of coal, including 4 inches of bituminous shale on top. On Whitsels run, the openings resemble that just given, except that the roof division shows only two layers of coal, each about ten inches thick. On this run the *Redstone coal bed* occurs at 50 feet above the *Pittsburg* and is said to be about 4 feet thick. It has not been opened.

Thus far the course of the river very nearly coincides with the strike and the rise of the coal is slight, barely thirty feet in a mile and a half, but at Whitsels run the direction is changed, and the coal rises so rapidly that within less than half a mile it is out of the river hills. The dip along this

portion of the out-crop is very near 4 degrees, and the available area of the coal is narrow. The *Redstone* is mined near Perryopolis, and shows the same characteristics as at the localities already referred to.

Opposite the residence of Mr. Elwell, and about three fourths of a mile above the mouth of Whitsels run, the Morgantown Sandstone is exposed in the bluff and makes a fine showing. Above it there is a yellow limestone 3 feet thick, and at a few feet below it is the *Barton coal*. The limestone is 260 feet above the track. In a ravine about one fourth of a mile further up the river, 15 feet of the sandstone are exposed, and at 80 feet below it is the Green or Crinoidal limestone, of which one foot was seen. The latter is 140 feet above the railroad track. A coal bed, 3 feet thick, is said to have been mined here, but its place cannot be determined with any degree of accuracy. Dumps evidently belonging to old coal openings were found at 85 feet below the limestone. At a short distance further up the river, a heavy sandstone rises above the track, and is exposed in two cuts along the railroad. It rises quite rapidly, and at Layton station forms a fine bluff in the hill. An old opening, in what is probably the same with the coal bed just referred to, was seen near the hill top back from the station, with the sandstone below it. At not far from 100 feet down the hill from this opening a second coal bed, barely one foot thick was seen, and at 35 feet lower a third bed, said to be 3 feet thick, has been opened, but the opening did not admit of measurement at the time of my visit. At a few feet lower is a layer of sandstone, 8 to 10 feet thick, which is crushed for the manufacture of glass-sand, the process being the same as that employed at the sand-works in Connellsville township.

The section displayed in the hill back from Layton station, belongs wholly to the Lower Barren Series. In the section obtained along the railroad in Tyrone township, the Layton rocks are represented by the portion from No. 10 to No. 20, inclusive. In that section, the top coal of Layton was not found. The exposure of its place seemed to be

complete, but the bed may be represented there by a thin carbonaceous shale, and so have escaped detection.

10. WASHINGTON TOWNSHIP, OF FAYETTE COUNTY.

This, which lies directly west from Perry, is the northern township along the Monongahela river. It is wholly within the Lisbon or Irwin synclinal, the axis of which crosses its south-east corner. The section extends from the *Washington coal bed* to 175 feet below the *Pittsburg*. The latter is readily available along the river front, as well as along most of the streams entering the river, and is so extensively mined that few openings have been made in the other coal beds.

On Little Redstone creek, near the junction of its forks, the *Pittsburg bed* is mined by Mr. Stephens, as well as by Mr. Butler. And at the former opening the section is:

1. Shale,	10'		
2. Roof division—			
Bituminous shale,	1'	} 8'	} 17' 2"
Shale,	5'		
Sandstone,	1'		
Coal,	1'		
3. Main clay,	1'		
4. Lower division,	8' 2"		

The sandstone of the roof division is seen at several other openings in the vicinity, but is by no means persistent. It is hard, compact, grayish-brown, and micaceous, with a laminate structure, and resists the action of the weather admirably. The lower division is broken into seven benches, of which the upper three, with a total thickness of 5 feet 9 inches, are equivalent to the ordinary upper bench. The "bearing-in" is double, 2 and 3 inches, and the "brick" and "lower bottom" are distinct. The partings are all thin, and can be traced only with difficulty in the sound coal. At the opening by the grist-mill, a little further down the stream, the coal in the roof varies from 3 to 10 inches, and the lower division has a constant thickness of 7 feet 6 inches. The numerous openings between this point and the river, show no difference in the section. In all, the upper bench yields the best coal, though in many

pits the "lower bottom" is the purest, but so soft as to be practically worthless. Almost directly below the coal, is a thin limestone, under which a small quantity of iron ore is occasionally found. At 15 feet lower is another limestone, which at one exposure is 15 feet thick.

On this stream the *Redstone coal* is 40 feet above the *Pittsburg*, and varies little from 3 feet, except where cut by clay veins or horsebacks. The coal is good, but is not mined. The *Sewickley* is not exposed at any place examined along the creek. From the mouth of the Little Redstone along the river to Fayette City, several openings in the *Pittsburg* were seen, but they differ from those already mentioned only in that the roof division contains additional layers of coal. The shale above the bed has layers of flaggy sandstone which are rudely ripple-marked, and show occasional indistinct impressions resembling those of fucoids. On a little run flowing past the glass-works and entering the river at the upper part of Fayette City, several openings in the *Pittsburg* were seen, one of which gave the following section:

1. Flaggy sandstone,	5'		
2. Shale,	4'		
3. Roof division—			
Bituminous shale,	4"	} 8' 9"	} 10' 11"
Brown shale,	1'		
Slaty coal,	10"		
Sandy shale,	10"		
Coal,	9"	} 10"	} 4"
4. Main clay,	10"		
5. Lower division, seen,	6'		

The brown shale of the roof contains much iron ore at this opening, but is free from it at all the others. The black shale above it is very compact, and has a cannel-like fracture. The lower division, as far as seen, is in three benches, 58, 3, and 15 inches thick, the upper one showing no partings of any sort, even on the long-weathered face. The lower bottom is not exposed, but it is said to be 1 foot thick, thus making the whole thickness of this division, 7 feet 4 inches. In the vicinity of Fayette City, this coal is mined extensively for shipment.

Somewhat further up this run, the *Redstone coal bed* has

been opened in a small way. It is from 3 to 4 feet thick, and yields an excellent coal, which is more easily mined than is that of the *Pittsburg*, and is said also to contain less ash. Unfortunately the bed is badly troubled by horsebacks and clay veins, the former sometimes cutting out half the coal. The *Sewickley* is seen higher up, but is only 2 feet 6 inches thick. The *Waynesburg* is not reached.

Crossing the ridge to Downers run, which enters the river at the lower end of Fayette City, one finds himself on the lower division of the Great Limestone. Up the stream, the two divisions of the Great Limestone and the Waynesburg Limestone successively disappear, the last just above the road to the Red Lion, or Redstone Post Office. The *Uniontown coal bed* is represented by only a thin carbonaceous shale, and the *Waynesburg* is concealed. On the Red Lion road there are no exposures until near the summit, where, at about 500 feet above the river, the blossom of the *Washington coal* is shown. At about a mile further, the Waynesburg Limestone is exposed, with the *Little Waynesburg coal bed* resting on it, and at 45 feet lower is the Uniontown or upper division of the Great Limestone. From this point to the township line there are no exposures. The *Waynesburg coal bed* has been opened on this road at two places, but, being only 4 feet thick in all, it was regarded as not worth working.

11. JEFFERSON TOWNSHIP, OF FAYETTE COUNTY.

This lies along the Monongahela river, south from Washington township. Its exposed section extends from 30 feet above the *Washington coal bed* to about 50 feet below the *Pittsburg*. It is crossed by the Lisbon (Irwin) Synclinal, which in its course southward is deflected fully two miles. This axis enters from Washington township, nearly half a mile from the Redstone Post Office, not far from the point where the north fork of Little Redstone first touches the township line. Its course is traced with the utmost difficulty, and is so obscure that the identifications of some of the upper coal beds may have been wrongly made. The deflection eastward in the course of the axis certainly does not

occur until more than two miles and a half south-south-west from the Redstone Post Office, but at a short distance further south, the central line of the trough is found within half a mile of the eastern line of the township, and so continues to Redstone creek, which it crosses just below Parkhill's mills. The whole township, therefore, lies within the Lisbon (Irwin) trough.

Along Redstone creek, the lower division of the Great Limestone is in the stream, at the line of Franklin township. Thence the rocks descend until at the Redstone Flouring-Mill, formerly Parkhill's, the upper or Uniontown division is under the water, and the Waynesburg Limestone is exposed in the railroad cut above. The dip is reversed just below this point, so that at the old paper-mill, the Uniontown Limestone is 20 feet above the stream, and at half a mile further down, the *Sewickley coal bed* comes up. It has been opened here, and is barely 2 feet thick, but is said to yield good coal. Somewhat less than a mile below the paper mill, a long railroad cut exposes the *Sewickley*, which is thrown into numerous short curves, and shows abrupt swells in thickness, varying from 8 to 18 inches, within a few feet. Between the coal and the limestone above, there are 3 feet of dull shale, containing calcareous nodules. Below the coal is a flaggy sandstone, with some sandy shale, in all about 25 feet thick. The flags are good, and from 2 to 10 inches. Below this the Fishpot Limestone is exposed near the bridge, and is nearly 30 feet thick. The *Pittsburg coal bed* is reached near Lyon's mill, where it is mined by Mr. W. M. Lyon, and is associated as follows :

1. Fishpot limestone,	25'
2. Shale,	40'
3. Carbonaceous shale,	2'
4. Shale,	15'
5. <i>Pittsburg coal bed</i> —	
Roof division,	5' }
Lower division, seen,	8' }
	13'

The roof division shows no coal whatever, and the lower division has no distinct partings. The quality of the coal is the same as at the openings to be described in Brownsville township. Below this, along the creek, there are no

openings in the bed until the Perryopolis road is reached, at a half mile from the river. Along this road, banks are numerous up to the first fork. In these the lower division is constant at about 8 feet, but the roof has changed from the last locality, and it now contains 8 inches of coal.

On the left hand fork, which leads to the Brownsville and Fayette city road, both the Fishpot and the Great Limestone, lower division, are exposed, respectively 35 and 65 feet thick. Above these are no other exposures until the Fayette city road is reached, where, on the property of Mr. J. Steel, there is a deserted opening in the *Washington coal bed*. Beyond this for half a mile northward, everything is concealed, but where the telegraph wires turn into this road the blossom of the *Waynesburg "a"* is shown, and at a little distance further the *Waynesburg* itself is similarly exposed. Respecting these three coals no information can be obtained, and the exposures are too imperfect to admit of measurement.

About one third of a mile from where the road strikes Little Redstone creek, the *Sewickley* is seen at the roadside, and the Fishpot Limestone is exposed in a hollow alongside. Near the creek, the *Redstone coal bed* makes a large blossom, and seems to be not far from 3 feet thick. It is 40 feet above the *Pittsburg*, which is opened at a short distance beyond, showing as follows:

- | | |
|--------------------------------|-----------|
| 1. Sandstone, | 15' |
| 2. Shale, | 6' to 12" |
| 3. <i>Pittsburg coal bed</i> — | |
| Roof division, | 3' 6" |
| Main clay, | 7" |
| Lower division, | 7' 2" |
| | } 11' 3" |
| 4. Fireclay, | 2' |
| 5. Limestone, | 2' to 3" |

The roof division shows five layers of coal and clay and contains only 20 inches of coal. The lower division is cut into three benches, 58, 8, and 20 inches, by thin partings which are so indistinct, that they can be traced only with difficulty even on the long weathered surface. From this point to the township line many openings were seen, but they closely resemble that just given.

The north fork of Little Redstone joins the south fork at about one fifth of a mile below the township line in Washington. Nearly one fourth of a mile from Redstone Post Office, this stream is crossed by a road leading south-south-west, which within half a mile becomes a private lane leading to the main fork of Little Redstone. About midway between the two streams it crosses a high hill near whose summit, on both sides, the Lower Washington Limestone was seen, with the *Washington coal bed* under it; but no determination of the thickness of either stratum could be made. Where the lane reaches the road following the main fork of the stream, the Waynesburg Limestone is shown, and opposite the school-house, half a mile further west, the Uniontown Limestone is exposed, but the coal is not present. The *Waynesburg coal bed* was observed near the Redstone Presbyterian church and the Uniontown Limestone was seen again half a mile further south. Beyond this point no more exposures occur on the road to the old paper-mill on Redstone, until the school-house is reached, where the *Washington coal* makes an extensive blossom.

On the road leading from Parkhill's mill on Redstone to Redstone Post Office, the *Waynesburg coal bed* was formerly mined at one fourth of a mile from the creek and its blossom is still very distinct in the road. The blossom of the *Waynesburg "a"* is exposed in its proper place above. At the cross-roads two miles north from the Methodist church, the *Washington (?) coal bed* has been opened by Mr. Robert Elliott at the very crest of the hill. The dip is north-west showing that the course of the axis southward is straight at least this far and that the deflection must occur further south. The section of the bed is:

1. Shale,	7'
2. Coal,	10 "
3. Clay,	2 " to 6"
4. Coal,	31 " to 43"
5. Clay,	1/2 " to 14"
6. Coal,	22 " to 35"

No limestone was found on the hill top, either in place or in fragments. But there is a limestone at 35 feet below the coal bed. The top bench is very bad coal, and the

middle bench is much broken by thick binders of clay. The clay, No. 5, is quite thin for the most part, but occasionally swells to the maximum thickness, given in the section. The whole bed yields poor coal, and but little is taken from it. On the road leading south-east from this point, and returning to this road at the Methodist church, the *Washington (?) coal bed* is seen on the higher summits, and is always accompanied by the thin rusty limestone below.

At the next cross-roads north, the *Waynesburg coal* is shown by its blossom, and seems to be quite thin. The Uniontown Limestone is shown where the road crosses the Little Redstone, but the coal is apparently absent. This limestone remains in sight to Redstone Post Office, where it is considerably above the creek, and the lower division of the Great Limestone is in the bed of the stream (north fork of Little Redstone). From this place along the road to Perryopolis, the Uniontown Limestone is constantly in sight to the township line.

Along the Monongahela river the *Pittsburg coal bed* is available, and the openings are quite numerous, especially near the northern line of the township. The Redstone is occasionally exposed, and shows a thickness varying from 2 feet 6 inches to 4 feet of very fair coal. The *Sewickley* is thin, and rarely seen, while the hills do not catch the *Waynesburg*. The *Uniontown coal* was not exposed at any of the localities examined. Among the most marked features along the river are the two limestones, the Great Limestone, lower division, and the Fishpot. The extreme thickness of the former is 90 feet, and of the latter, 30 feet. This is of excellent quality, and at Greenfield, on the opposite side of the river, is quarried for shipping.

12. FRANKLIN TOWNSHIP, OF FAYETTE COUNTY.

This lies along the Youghiogheny river, between Perry and Dunbar townships. The Saltsburg axis enters it at two miles above Layton, on the Youghiogheny, passes a little way west from Flatwoods Post Office, and goes out of the township near Work's distillery, on Redstone creek.

Franklin township, therefore, embraces portions of both the Lisbon (Irwin) and the Blairsville trough. The exposed section reaches from the *Waynesburg* coal, to 40 feet below the *Upper Freeport* coal bed. Except on Redstone creek and the Youghiogheny river, the exposures of the lower rocks are meager, and at best a satisfactory section cannot be obtained without an expenditure of time and energy altogether disproportionate to the result. Erosion has acted energetically along the line of the anticlinal, removing the upper coals from a broad belt, which widens northward.

Along Redstone the barren space extends from Vance's mill almost to the western line of the township. The *Pittsburg* is caught in some high hills well up on Bolden's run, but thence the out-crop runs north-east, and reaches the Youghiogheny hills at a little below East Liberty, in Dunbar township. In the Lisbon trough, the out-crop line of the *Pittsburg* coal bed leaves the creek at Sharpless' mill, and runs north-east for nearly a mile, when it turns, and follows an almost due north direction to the line of Perry township. It will be seen, therefore, that the available area of coal is limited to a narrow strip on each side of the township, leaving by far the greater portion barren.

In the north-western part, along Crabapple run, the *Pittsburg* bed is mined by Mr. Hazen and Mr. Burton, and remains above water-level almost to the line of Jefferson township. At Mr. Hazen's bank the section is :

1. Roof division—			}	2' 11"	10' 7"
Bituminous shale,	4"				
Coal,	1'				
Clay,	4"				
Coal,	4"				
Clay,	6"				
Coal,	5"				
2. Main clay,		8"	}		
3. Lower division, seen,	7'				

The usual partings are said to exist in the lower division, but they are so thin that I was unable to recognize them, even on the long weathered surface at the mouth of the pit. Mr. Burton's opening shows a similar section.

On the ridge, between this and Shearer's hollow, the

Pittsburg was seen, and over it 40 feet of carbonaceous shale holding, midway, 2 feet of coaly shale representing the *Redstone coal bed*. Further up the hill, the Fishpot Limestone is seen, its upper surface at 85 feet above the *Pittsburg coal*. The lower division of the Great Limestone is exposed in fragments at 30 feet above the last. In Shearer's hollow, the *Pittsburg coal* is opened, and at one pit the lower division shows three benches, 60, 3, and 15 inches thick, with the "lower bottom" not exposed. The partings are thin and the coal is of excellent quality. From these openings the rocks dip very rapidly, so that before the road reaches the creek it has crossed the Fishpot Limestone. Along the creek, beginning at the line of Jefferson township, and ascending to a little way above Cook's mills, the following section was obtained the distance being rather less more than half a mile:

Fig. 26.

1. <i>Waynesb'g coal bed</i>,		..... Blossom.
2. Sandstone,	30	..... 30'
3. <i>L'tle W'sb'g coal bed</i>		..... Blossom.
4. <i>Waynesb'g limest'e</i> ,	20	..... 20'
5. Sandy shale, . . .	45	..... 45'
6. Uniont'n limestone,	15	..... 15'
7. Sandstone,	25	..... 25'
8. Limestone,	20	..... 20'
9. Sandstone,	20	..... 20'
10. Limestone,	35	..... 35'
11. Clay, . . . . .		..... 3' to 12'
12. <i>Sewickley coal bed</i>,		..... 2' to 2' 6"
13. Sandy shale, . . .	25	..... 25'
14. Fishpot limestone,	25	..... 25'

Upper Coals on Redstone Creek.

The *Waynesburg coal bed* is not mined in this portion of the township, and the *Uniontown coal* is clearly absent, its place being fully exposed. The lower division of the Great Limestone is double, and is represented by Nos. 8 and 10.

These are not wholly limestone but consist of many layers separated by thin shales, the proportion of the latter being not far from one fourth of the whole mass. The lower portion of No. 10 is a dull grayish rock, breaking with a dead surface and soon disintegrating on exposure. It has been burned and ground to test its value as a cement rock, and has been found admirably fitted for that purpose. The *Sewickley coal* describes a series of short irregular curves, as though it had rested on an insecure mud surface, which was thrust up into rude hummocks after the coal had been laid down. These hummocks could hardly have existed before the coal, for that shows no thinning toward their crests, but crosses them undiminished. As they vary from one to four feet in height it seems impossible that, had they been formed before the coal, some one or more of them would not have cut out the coal so as to destroy the apparent continuity of the bed. The exposure is continuous in a railroad cut for hundreds of feet.

In this cut, a mass of compact limestone is partially embedded in the *Sewickley coal bed*, projecting above and below it. It is irregular in form, and gives evidence of having been much water-worn before it was deposited here. The block is not a concretion but a transported fragment, which belongs to neither the Great Limestone above nor the Fishpot Limestone below, for it has no resemblance to any layer of either of those strata. The crush in the coal shows that it was not dropped before the formation of the coal, otherwise that material would have been deposited regularly about the fragment, whereas it is much distorted. It was most probably dropped by some floating tree trunk after the water had become deep, and, falling through a number of feet, was able to force its way through the mud, covering the coal, as well as through the coal itself, and to penetrate into the soft clay below.

The sandy shale under the coal contains layers of flaggy sandstone, as usual. The Fishpot Limestone is good. In a boring made near Cook's mills, on the opposite side of the creek, the *Pittsburg coal bed* is said to have been reached

at 120 feet from the surface, which would make the interval between it and the *Sewickley* about the same.

Ascending the creek, the shales underlying the Fishpot Limestone are seen, and at somewhat more than half a mile above Cook's mills the *Pittsburg coal bed* comes up and is worked by Mr. Rittenhouse, and on the property of the McCormack heirs. At neither opening is the roof division exposed, and at the latter the lower division shows the usual benches, 57, 7½, 13, and 14 inches thick. The second or "bearing-in" is double. In the upper bench the coal, for 20 inches from the top, is mixed with clay, so as to be inferior to other portions of the bed. The "lower bottom" is soft, but otherwise is good. Up the creek the coal remains at only a few feet above the water as far as Sharpless' mill, as the course of the creek almost co-incides with the strike, but at the mill the course changes and the coal rapidly recedes. The final out-crop is at somewhat more than one third of a mile west from the Uniontown and Perryopolis road, and the last bank is that belonging to Mr. Frasher. The geology along Redstone creek, from Sharpless' mill to Upper Middletown, is given in the description of Manellen township.

It the central part of the township, through which the axis passes, carrying a broad band from which the *Pittsburg coal bed* and the upper strata of the Lower Barren Series have been removed, there are no connected exposures. None of the streams cuts deeply enough to reach any rock of economical importance. Along the Youghiogheny river the Lower Productive Coal Series is shown in part, but there the coal is of no value. The details of this line are given in the description of Tyrone township.

In the eastern part of the township the *Pittsburg coal bed* is well exposed, and the out-crop line lies within this township from Redstone creek almost to the Youghiogheny river. The road along Butes run, which enters Redstone near Vance's mill, is on or very near the level of the coal for nearly three miles, and does not finally rise above it until the divide is approached, about four miles from East Liberty. The out-crop of the bed lies east from the road for about a mile, beyond which it passes to the west side

and runs one fourth, one half, and at last three fourths of a mile west from the road at the township line. Small outliers are caught in hills east from this line, near Vance's mill, and one is seen on the property of Mrs. Work. About half a mile from Redstone creek the coal is mined by Mr. J. Patterson, at whose bank the following exposure occurs:

1. Sandstone,	3'	
2. Shale,	5'	
3. Roof division—		
Carb. shale,	10"	} 2' 6"
Coal and clay,	8"	
Clay,	4"	
Coal,	8"	
4. Main clay,	10"	} 11' 4"
5. Lower division,	8'	

The partings are thin and not persistent. The last openings seen along this run are those belonging to Mr. Long and Mr. Barkilow. In the latter the section is:

1. Shale,	3'	
2. Roof division—		
Coal,	2"	} 1' 8"
Clay,	4"	
Coal,	1' 2"	
3. Main clay,	10"	} 9' 8"
4. Lower division, seen,	7' 2"	

In No. 4 only two partings, 5 inches apart and 36 inches below the main clay, are persistent. Others were seen, but they are merely binders. Many other openings were examined along the out-crop, but they resemble those just given and the thickness of the lower division varies only between 8 and 9 feet.

13. MANELLEN TOWNSHIP, OF FAYETTE COUNTY.

This lies south from Franklin and west from North and South Union. The Saltsburg anticlinal enters it on Redstone creek below the distillery, at rather more than a mile and a half below Upper Middletown. Before reaching the National road, it is thrown eastward nearly two miles, and crosses that road about one fourth of a mile north-west from the school-house. Thence it continues in a straight line, and crosses the McClellandtown road at Watson's knob, on the line of German township. Manellen township, therefore,

like Franklin, embraces portions of both the Lisbon (Irwin) and the Blairsville trough. The exposed section extends from 150 feet above the *Waynesburg coal bed* to about 40 feet below the *Upper Freeport coal*.

In the extreme southern part the *Pittsburg coal bed* passes over the Saltsburg axis, but south from the National pike to the New Salem road, only two patches of that bed were seen, and they are high up on the axis. Northward from the pike to Redstone creek, a band more than two miles wide is wholly destitute of coal, but on the creek, under the arch of the anticlinal, two small coal beds belonging to the Lower Productive Coal Series are brought up and one of them is mined. These are not reached in the southern portion of the township, as no stream cuts deeply enough to expose them.

Along the McClellandtown road, which crosses the extreme southern part, the *Pittsburg coal bed* is available nearly all the way. It is well exposed on Watson's knob, where the openings show the lower division to be about 7 feet thick. Half a mile east from that hill is an opening belonging to Mr. Levi Beal, which is 85 feet lower than those on Watson's knob, and shows the following section :

Roof division—			} 3' 4"	} 13'
Carb. shale,	6"			
Clay and coal,	2' 0"			
Carb. shale,	10"			
Main clay parting,	1' 2"			
Lower division,	8' 6"			

Above the roof as given, there is a mass of dark shale, 7 feet thick, which contains a very considerable quantity of carbonaceous matter. The lower division is said to reach 11 feet at some places in the pit, but the extremes observed by me are 7 feet and 8 feet 6 inches. The coal is clean, somewhat soft and, if one may judge from physical characters alone, it should make a good coke. On the adjacent property, belonging to Mr. J. M. Thompson, this bed is worked to a considerable extent and shows similar structure. The bed goes under the surface just before reaching Jennings run, the eastern boundary of the township.

On the road from Uniontown to New Salem, which passes

about a mile north from the last, the out-crop of the *Pittsburg* in the Blairsville trough lies in South Union township, and no coal is seen on the road going westward for somewhat more than two miles and a half. But at half a mile north from the road, on property belonging, according to the old map, to J. Woodward, there is an area of a few acres, and a similar one occurs at half a mile further north. Aside from these insignificant patches, no coal occurs in the space between this road and the National pike, from the township line to a road passing north, at a mile west from the new school-house.

About a mile from the school-house, the *Pittsburg* coal is caught in the hills, and thence descends rapidly until it comes down to the creek, at a mile from New Salem. The first opening east from that village belongs to Mr. S. E. Findlay. The roof is concealed, excepting 10 inches of carbonaceous shale resting on the main clay parting. The latter is only from 1 to 3 inches thick, is very hard, and so badly slickensided as to be a very insecure roof. It is removed to prevent accidents. The lower division has the following structure :

Upper bench, 59 inches ; Bearing-in, 7 inches ; brick, 21 inches ; lower bottom, 16 inches.

The dip is at the rate of 320 feet per mile north-west as far as the entry continues. The "lower bottom" bench is decidedly inferior and is not always removed from the mine. Mr. Hackney's opening on the adjoining farm has a similar structure.

Just beyond these pits the coal goes under the stream, and thence to New Salem there are no exposures, the Great Limestone being concealed. At the cross-roads in that village, the *Pittsburg* coal is not far from 300 feet below the surface, as determined by the rate of dip. About one eighth of a mile west from the village, the blossom of the *Waynesburg* coal bed is seen at the roadside.

On the road leading up the north fork of Dunlaps creek, from the township line to Searight's, on the National road, there are few exposures, but the *Waynesburg* Limestone is

occasionally seen for a distance of a mile and a half from the pike.

On the second road turning north, east from New Salem, a deserted opening in the *Pittsburg* was seen, which shows the structure of the roof division as follows :

Coal,	1'	}	3' 4"
Coal and Clay,	1' 4"		
Bituminous shale,	1'		

In the middle portion of the roof, the coal is in small quantity, and occurs only in thin streaks. The dip is very sharp, but the hills are high, so that the out crop is not reached for nearly half a mile further east. At little more than half a mile north from this opening is one belonging to Mr. H. Miller, where the face of the coal is exposed by a little run for more than 100 feet, and long exposure to the weather has brought out the structure of the bed very distinctly. The partings are very thin, and for the most part are composed of a compact carbonaceous clay, which is so coal-like, that they are traceable only with difficulty when the coal is sound. The roof is imperfectly shown, and the main clay parting is but 6 inches thick. The lower division is 8 feet 2 inches, and is in four benches, 30, 23, 22, and 20 inches respectively, which are separated by partings varying from one eighth to one fourth of an inch. The second bench is badly broken up by thin slates, showing five in all, and the bearing-in is at its base.

At one third of a mile from Mr. Miller's house, the road reaches a branch of Dunlaps creek, which it follows to the National pike. This line marks the western limit of the coal, which there passes below the surface. It is mined for domestic use by Mr. Jeffers, Mr. Dearth, and Mr. Wood, at whose openings it is the same as at Mr. Miller's pit. Below Mr. Jeffers, the stream flows westward, and before reaching the road, previously referred to as leading to Searights, it exposes the Waynesburg Limestone.

On the National road, the *Washington coal bed* is exposed just beyond the western border of the township, but from that point to Searight's everything is concealed. In the hill south from the road at the latter place, there is a flaggy sand-

stone overlying a thin coal bed, below which at a few feet is a limestone, the whole representing the *Waynesburg* rocks. At the cross-roads, there is a flaggy sandstone, and under it the Uniontown division of the Great Limestone is exposed. The *Waynesburg* Limestone is again seen in the summit east from Searight's, which is its most easterly exposure in the Lisbon trough within this township. At a little distance further east the Uniontown Limestone is shown.

The *Pittsburg* coal bed is reached at the first cross-roads, rather more than a mile east from Searight's, and is worked by Mr. Wood. The blossom of the *Redstone* is at 25 feet above it. Mr. Wood's opening in the *Pittsburg* shows three well-defined benches in the lower division, 50, 21, and 31 inches thick, and separated by exceedingly thin partings. No other partings could be distinguished on the face. From this point eastward, the coal remains in sight along the pike for half a mile, and has been opened very near the final out-crop.

At the school-house, just east from the crest of the anti-clinal, the summit is 40 feet higher than the coal at the out-crop, and is evidently not less than 100 feet below the coal, but no exposures occur to aid one in making an exact determination. Thence the rocks fall rapidly to the south-east, and the coal is again reached at one eighth of a mile from the township line, being worked just beyond that line, in both North and South Union. The south-east dip from the out-crop to the openings is 350 feet per mile. On the west side of the axis it is rather greater.

Along Jennings run, the eastern boundary of the township, the out-crop of the *Pittsburg* bed lies in Manellen for a short distance, both north and south from the National road, and then on each side crosses into the adjoining township. Nearly half a mile north from the pike, is Mr. Springer's opening, within a hundred yards of the run, and near the crest of a high hill. It is in a very small area. The coal is caught near the summits of two hills, at a short distance south from the pike, but long before the New Salem road is reached, the line of out-crop has crossed over into South Union township.

It will be seen by reference to the map that the out-crop line on the west side of the Saltsburg axis is abruptly deflected at a little way north from the pike. This is due to the deflection of the axis as well as to the increased height of the axis. Had the course remained unchanged, going northward, the axis would have crossed Redstone creek above Upper Middletown, and the coal out-crop, had the hills retained the same height as now, would have lain east from the road between the pike and Upper Middletown, whereas now that line lies from half a mile to a mile west from that road. The available area of the *Pittsburg coal* is barely half a mile wide and lies almost north and south, beginning on Mr. Hill's property in the extreme northern portion of the township and passing southward to a run, which enters Redstone creek about a mile below Upper Middletown. Along this run it is worked for nearly two miles, being opened by Messrs. Hess, Cowell, Veil, and Piersell. At Mr. Hess' opening the bed shows:

Roof division,	1' to 1' 6"	} 11' to 11' 6"
Main clay,	1'	
Lower division,	9'	

The roof division consists wholly of coal, which is quite good and is used for fuel. The lower division contains but one parting, which is 2 inches thick and 2 feet from the bottom. The bed is good throughout, though occasionally that below the parting is somewhat inferior. The coal seems to be quite free-burning and yields a powdery yellow ash. The under clay sometimes swells so as to displace 2 or 3 feet of the coal for a horizontal distance of 25 feet. The other openings along this run show the same character.

Following up the road past Mr. Hess' bank, one soon sees the blossom of the *Redstone* at 25 feet above the *Pittsburg*, and near the school-house the blossom of the *Waynesburg* is exposed. This coal was worked here at one time but all the openings have been deserted. It is said to be about 4 feet thick. The school-house at the cross-roads stands on the *Waynesburg Sandstone*. On this road the *Waynesburg coal bed* is again seen near the line of Redstone township.

Northward from the school-house, there are no exposures and at the township line the road is about 150 feet above the *Waynesburg coal*. Southward from the school-house, on the way to Searight's, the *Waynesburg coal* and its limestone are frequently exposed in the road to within half a mile of the National road, and at one place, about midway between the school-house and the pike the Uniontown Limestone was seen. No openings in the *Waynesburg coal* were found along this road.

Along Redstone creek the Upper Productive Coal Series is not reached in the immediate vicinity of the stream until near the line of Redstone township, at Sharpless' mill, where the *Pittsburg coal bed* comes down to the creek and is mined. The Saltsburg anticlinal, which crosses the creek below Wood's distillery brings up some beds which certainly belong to the Lower Productive Coals, but no detailed section can be obtained along the stream and it is difficult to determine with accuracy the interval between these coals and the *Pittsburg*. Just above Upper Middletown there comes up from the creek a bed of coal varying from 35 to 38 inches in thickness, which has been opened at two places between that village and the creek. Three fourths of a mile further down the stream, it is worked by Mrs. Thompson on a little tributary, where the following section was obtained :

1. Sandstone,	40'
2. Concealed,	10'
3. Limestone,	4'
4. Concealed,	150'
5. Coal bed,	1 6"
6. Sandstone and shale,	25'
7. Sandy shale,	12'
8. Clay shale,	6'
9. Coal bed,	8'
10. Shale,	8'
Total,	259' 6"

The sandstone, No. 1, is gray on the weathered surface, and in some places is massive. Large fragments of it are found on top of the hills bordering the creek. The limestone is hard, brittle, slightly ferruginous and is imperfect-

ly exposed. It contains occasional fossils. Fragments of the Green or Crinoidal limestone were found near the coal, No. 5, but the rock was not seen in place, unless No. 3 be a portion of it, which is doubtful. No. 9 is the bed mined at Upper Middletown, and is said to yield excellent coal; but it is too thin to repay working. On the other side of the axis it comes down to the creek where the road crosses into Franklin township, and many years ago it was stripped from the bed of the stream at that place. No openings were found in the coal bed No. 5. It was seen in a railroad cutting below Wood's distillery, where it is barely one foot thick.

The interval between the lower coal and the *Pittsburg* is not less than 550 feet, that interval having been followed out without finding any traces of the upper bed. There is, therefore, no reason to doubt that the coal beds of the section belong to the *Freeport group* of the Lower Productive Coal Series.

14. REDSTONE TOWNSHIP, OF FAYETTE COUNTY.

This lies directly west from Manellen. At the south and south-west, Dunlap's creek separates it from Luzerne, and at the north Redstone creek separates it from Jefferson. The axis of the Lisbon (Irwin) synclinal passes through it, entering near Parkhill's mills on Redstone, crossing the National road near Mr. G. Colley's house, and Dunlap's creek near Mr. Hibb's house. The section extends from about 400 feet above the *Waynesburg* to 30 feet below the *Pittsburg coal bed*. Exposures of the higher rocks are exceedingly imperfect, so that no detailed section can be made out above the *Waynesburg "a" coal bed*.

Along the National road, which crosses the township in a north-west and south-east direction, one finds the *Waynesburg coal bed* only a few feet below the surface at the western boundary of the township, but, owing to the rapid dip of the rocks, the *Waynesburg "a"* is in the road at the first fork east, where Limestone *Ia* is associated with it. This coal remains in sight for some distance as the road descends sharply, but goes under just west from the Christian

chapel. On the hill, immediately back of that church, the *Washington coal bed* is exposed, but no limestone appears with it, and the interval between it and the *Waynesburg "a"* is occupied by shale and sandstone, Limestone "*Ib*" being absent. At the election-house, Limestone III of the Washington County Group is seen in the road, and at the next cross-roads east, the *Jolleytown coal bed* is exposed by its blossom, underlying a thick sandstone. About a mile further east, in a hollow west from Mr. Colley's house, Limestone III is again reached, and shows its usual character, weathering yellow, with dark patches on the weathered surface. Near this the line of the synclinal passes, for at a little distance east, at the next fork, the Lower Washington (Limestone II) is partially exposed. Thence, eastward the road rises more rapidly than the rocks, so that at the saddlery shop it is at a very considerable distance above Limestone II. Near the township line, the *Washington coal* is shown, but the Lower Washington Limestone is concealed.

The road, turning northward at the saddlery shop, soon rises to the summit of the divide between the waters of the Redstone and those of Dunlaps creek. Near the crest of this ridge, there lie scattered over the face of the hill enormous blocks of a coarse sandstone, much like the *Waynesburg* on its weathered surface. This is undoubtedly the rock underlying the Upper Washington Limestone, but no fragments of that stratum could be found, though the hill is high enough to catch it. At 360 feet below the highest fragment, the road in crossing a little run exposes the blossom of the *Waynesburg coal bed*, and at 25 feet lower, the *Waynesburg Limestone* with the *Little Waynesburg coal bed* above it. Making proper allowance for dip, the interval between the sandstone and the coal is about 330 feet.

Just beyond this the road forks. The fork leading westward soon crosses another run, and on the other side exposes the *Waynesburg coal bed* separated from the *Waynesburg Sandstone* by 10 feet of clay. Of the sandstone, 45 feet are exposed, and, as seen in the bluff, it is irregularly bedded, soft and apt to weather with a honeycombed sur-

face ; but in the road it is quite compact, though soft and breaking down to a loose sand. It shows some layers of conglomerate. Above this stratum there are no exposures until the next fork in the road is reached, at the summit of the hill, where the higher sandstone, already referred to, is well shown in place. It is 10 feet thick, massive, dips sharply north-west, and forms a bluff, extending for nearly 200 yards. It is the same with that which on the National road overlies the *Jolleytown coal bed*. At the next fork in this road, a thin coal bed was seen, and on the road leading thence to the National pike, fragments of limestone are quite numerous. Both the coal and limestone clearly underlie the sandstone.

The *Pittsburg coal bed* comes down almost to the level of Redstone creek, near the line between Redstone and Manellen townships, but, owing to the course of the stream, does not go under it until within a mile of Cook's mills. Thence along the creek there are no exposures above the mill, where the coal is 120 feet below the surface. From this point, down the creek, the exposures are poor on the south side of the creek, but the section is the same as that already given for Jefferson and Franklin townships. The *Sewickley coal* has been rudely worked where it comes up from the bed of the stream, at somewhat less than two miles below Parkhill's mills, and has a thickness of not far from 2 feet. Above Lyon's mills, the *Pittsburg* comes up, and is mined at several places along the stream. Its character is the same as the banks described in Jefferson and Brownsville townships.

On the road leading from Cook's mills to Searights, on the National pike, the lower portions of the Great Limestone are exposed near the creek, but above this everything is concealed to near the hill top, where the Waynesburg Sandstone is well shown, forming a cliff 30 to 40 feet high, with a talus at its base, which conceals all underlying rocks. The sandstone is irregular, and its surface is badly shattered. At somewhat more than a half a mile from the mills, the *Waynesburg "a"* makes a very large blossom at the roadside, and is not less than 2 feet thick. Its coal is brit-

tle, and shows a tendency to weather into prisms. At a short distance beyond, the *Waynesburg coal bed* was seen. Thence to within half a mile of the township line, its blossom frequently appears in the road, but as no openings have been made, the thickness of the bed cannot be ascertained.

Leaving the creek at Parkhill's mills, and taking the Brownsville road, one soon comes to an opening in the *Waynesburg*, belonging to Mr. W. Norcross, which shows the following section:

1. Waynesburg sandstone, seen,	5'	}	10' 3"
2. Shale,	1'		
3. Coal,	4"		
4. Shale, with some iron ore,	5'		
5. Coal,	4"		
6. Clay,	2"		
7. Bone Coal,	4"		
8. Coal,	1' 8"		
9. Clay,	2" to 6"		
10. Coal,	2' 5"		

No. 7 is common to all the openings along this road, and is characterized by vertical planes of cleavage, by which it is cut up into blocks. It is known as the "brick," and is almost worthless, owing to the large proportion of ash. In No. 4 there are occasional nodules of iron ore, and indistinct impressions of plants. The coal from Nos. 8 and 10 contains much ash and sulphur. On Mr. Norcross' property the *Little Waynesburg coal bed* is 30 feet below the *Waynesburg*, and rests directly on the *Waynesburg Limestone*. It is said to be 2 feet 6 inches thick, and to yield much better coal than that obtained from the *Waynesburg*. From this point to the Baptist church, the blossom of the *Waynesburg coal* is frequently seen, and at the church, that of the *Little Waynesburg* is exposed. The section there to the run is:

1. <i>Waynesburg coal bed</i> ,	Blossom.
2. Sandstone,	30'
3. <i>Little Waynesburg coal bed</i> ,	Blossom.
4. <i>Waynesburg limestone</i> ,	15'
5. Sandstone and shale,	45'
6. <i>Uniontown limestone</i> ,	12'

The *Uniontown coal bed* is absent here, as at all points

along the creek where its horizon is exposed within this township. The upper part of No. 6 is highly carbonaceous, and may represent that coal bed. The lower part is ferruginous.

Beyond the church to within sight of the National road the *Waynesburg coal* and its limestone are frequently exposed. Near that road the coal is mined by Mr. Lancaster and Mr. Price, at whose openings the section is :

Waynesburg coal bed—

1. Coal and clay,	1' 2"	2'
2. Clay,	2"	2"
3. Coal,	2' 2"	2' 1" to 1' 8"
4. Clay,	3" to 10"	1' 3" to 4"
5. Coal,	2' 4"	2' 4"

In No. 3 is included the brick coal already referred to, which shows a constant thickness of 4 inches in both openings. The remaining portion of No. 3 is said to yield the best coal in the bed, as No. 5 contains much ash and sulphur. The parting No. 4 varies at the expense of No. 3.

At a little way west from this, a road leads southward from the National pike toward Dunlap's creek. On this the *Waynesburg "a"* is exposed near the pike with Limestone "*1a*" resting on it, and the barometer makes the interval between it and the *Waynesburg coal bed* only 55 feet. On this road Mr. Gardwood mines the *Waynesburg*, which shows the ordinary three benches 14, 22, and 18 inches thick, separated by 2 and 11 inches of clay. The Bottom bench is not fully exposed. Mr. Braithwaite's opening in the immediate vicinity shows a similar structure. At Mr. R. P. Brashear's bank, near the pike, and a mile east from the last the "brick" varies from 6 to 7 inches and the lower parting from 1 inch to 1 foot. Just west from the Christian chapel, a road leaves the pike and leads to Young's mill on Dunlaps creek. The *Waynesburg coal* has been stripped out of the run flowing by this road and where it strikes the road is 140 feet below the *Washington coal bed* as exposed behind the chapel on the pike. At 30 feet lower is the *Waynesburg Limestone*, and at 80 feet, the blossom of the *Uniontown coal bed* crosses the road. The *Little Waynesburg*, if present, is concealed.

In all openings on the *Waynesburg*, the brick layer is present and is altogether worthless. The other portions of the bed yield a coal which is a good fuel, in grates, but it burns away quickly and leaves much ash, so that it is inconvenient in close stoves.

Along Dunlap's creek, the *Pittsburg coal bed* is available for half a mile above the township line, but no openings were seen in it. At a mile above the line, the *Waynesburg coal* is caught by the hills bordering on the creek, and thence continues above the water-level to somewhat more than a mile above Merrittstown. The first opening is that of Mr. Gardwood, already mentioned. At nearly two miles due south from this, the coal is mined extensively by Mr. Craft and Mr. J. Armstrong. At the latter opening it shows:

Coal,	1'	} 7' 2" to 6'
Brick,	6"	
Coal,	1' 6"	
Clay,	2' to 10"	
Coal,	2' 2"	

The upper parting is merged into the brick layer, which, as usual, is almost worthless. The rest of the bed yields a very fair fuel. The *Waynesburg Sandstone* is directly above the coal, and has been quarried for flagging stone. On the hill, the blossom of the *Waynesburg "a"* is seen underlying *Limestone Ia*, which is said to be 3 feet thick, and of excellent quality. In the creek, at about 80 feet below the *Waynesburg*, the *Uniontown coal* is partly exposed. At one time it was dug here, and was found only 20 inches thick. On the opposite side, where it is 30 feet above the stream, an old opening shows it 30 inches thick, with a clay parting midway. The dip at this locality is slightly northward.

Nearly a mile further up the stream, the coal is mined by Mr. E. Vankirk. His opening is somewhat higher than Mr. Armstrong's, though it is dipping south-east, so that a slight fold must cross the creek between the two openings. Here the bed averages in all about 7 feet 8 inches, and contains more than 5 feet 6 inches of coal. The

upper clay parting is absent, but the brick layer is 8 inches thick. The bottom layer of coal is 3 feet, and has a slaty layer near the base. The Waynesburg Sandstone rests directly on the coal, and is exposed to the thickness of 15 feet. It is compact and makes so good a roof that there are rooms in this pit, 16 by 60 feet, which have no supports of any sort. The last exposure along the creek is at another opening one mile above the last and belonging to Mr. Vankirk. The section at the mouth of this pit is:

1. Waynesburg sandstone, seen,	8'
2. Coal,	0' to 6"
3. Sandstone,	10"
4. Coal,	1' 6" to 0"
5. Clay,	1' 3" to 1"
6. Coal,	3'

The only feature of interest is the sandstone horseback beginning at 4 feet from the mouth and continuing for 35 feet along the entry. Throughout the main entry the sandstone rests directly on the coal. At the mouth of the pit all the layers given in the section are present, and Nos. 2, 3, and 4 follow all the contortions of the sandstone roof. At 4 feet from the pit-mouth the sandstone No. 1 comes down and cuts out everything to No. 6, No. 3 being continuous with it. At 35 feet from the mouth, Nos. 4 and 5 re-appear and at 45 feet the sandstone No. 3 disappears, giving place to the normal clay parting and the brick layer. This horseback must have been formed when the coal and sandstone were still unconsolidated.

Barely half a mile further up the creek, the *Washington coal bed* was once opened by Mr. Gribble. The pit has been deserted for more than ten years and the coal is now so covered by debris that nothing respecting it can be ascertained without extensive excavation. A person, who drew coal from this pit many years ago, says that the bed is nearly 7 feet in all, and consists of four layers of coal separated by thick clay partings. In quality the coal differs little from that obtained from the *Waynesburg*. Limestone II was seen above the coal, and Limestone Ia is exposed in the creek bank at a short distance below. The hill is high enough to catch the Upper Washington

Limestone, but above the Lower Washington Limestone nothing is exposed.

From this point to the township line little is shown. The *Washington coal bed* was traced to Mr. Hibb's residence, where it was once opened under the road. Below that it is in the bed of the creek, and the synclinal crosses the stream at a quarter of a mile below the house. At the township line the creek is not far from the *Waynesburg coal bed*.

15. BROWNSVILLE TOWNSHIP, OF FAYETTE COUNTY.

This little township lies along the Monongahela river and adjoins Redstone. For convenience sake I include in it the boroughs of Brownsville and Bridgeport. It is on the western side of the Lisbon (Irwin) trough, and the section extends from the *Washington coal bed* to 30 feet below the *Pittsburg*, but no section can be obtained above the *Waynesburg Sandstone*.

Between the National road and Redstone creek, a cluster of hills rises fully two hundred feet above the top of this section, but they afford no exposures.

Along Dunlap's creek the *Pittsburg coal* is above water level to the township line. On the south side it has been almost wholly removed by mining. On the north side it is worked by Mr. Krepps, at whose opening it shows :

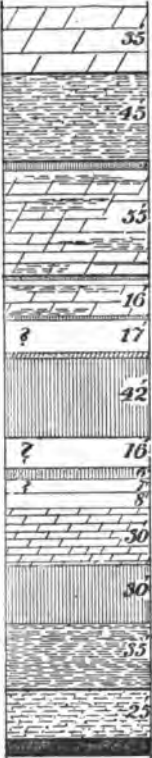
Roof division, 3 inches ; main clay, 1 foot ; lower division, 7 feet 8 inches.

The lower division sometimes becomes fully 9 feet, and is usually somewhat more than 8 feet 6 inches, the variations being caused by swells of the underclay, which occasionally displace two feet of the coal. This division shows no persistent partings and yields good coal from top to bottom. The thin roof is coal, and is not persistent. Along the bluff for some distance above this opening, the section between the *Pittsburg* and the place of the *Sewickley coal bed* is constantly exposed. The *Redstone* is represented by from 6 to 12 inches of hard carbonaceous shale, with cleavage planes dividing it into blocks which break with a canal-like fracture. Sometimes it is only a carbonaceous clay,

8 to 10 inches thick. These changes in thickness and character are abrupt and all of them may be seen within a space of one hundred yards.

About half a mile from the township line on the pike, the Waynesburg Sandstone is quarried, and the blossom of the coal is seen under it. Descending from this point to Dunlap's creek the following section was made out:

Fig. 27.

1. Waynesburg sandstone, seen . . .		35'
2. Waynesb'g coal bed,		Blossom.
3. Sandy shale,		45' ?
4. Lit. W'b'g coal bed,		Blossom.
5. W'burg limestone,		4'
6. Sh'l and shaly sandstone,		55'
7. Uniont'wn coal bed,		Blossom.
8. Coarse y'w limest'le,		1'
9. Clay,		3'
10. Shale and sandstone		16'
11. Limestone,		2'
12. Concealed,		17'
13. Sandstone,		3'
14. Limestone and sh'l,		42'
15. Concealed,		16'
16. Limestone,		6'
17. Concealed,		7'
18. Clay shale,		8'
19. Place of the Sewickley coal bed, . . .		—
20. Sandy shale and flaggy sandstone,		30'
21. Fishpot limestone,		30'
22. Shale,		85'
23. Redstone coal bed,		6"
24. Sandy shale,		25'
25. Pittsburg coal bed,		9'

Upper Coals at Brownsville.

The Fishpot Limestone, as exposed here, is about 35 feet thick. At the base, for about ten feet, it is quite ferruginous, but the rest of the bed is very clean and yields a lime of excellent quality. It is quarried for this purpose by Mr. Krepps. The ferruginous portion is said to make strong lime, but at this quarry it is not removed. Along this bluff

the place of the *Sewickley coal bed* is frequently exposed, but that bed is wholly unrepresented, there being not even carbonaceous shale in its place. The sandstone immediately above the Fishpot Limestone is for the most part a sandy shale, but in it there are some layers, perhaps ten feet thick in all, which are good flagging stone, and they have been used for this purpose. The lower division of the Great Limestone is occasionally exposed in the hills, but nowhere more fully than is given in the section.

Further up the stream the *Pittsburg coal bed* shows its normal structure, and at Mr. Wood's bank the section is:

Roof division, 8 inches ; main clay, 10 inches ; lower division, 7 feet 6 inches.

The lower division is in four benches, respectively 53, 5, 4, and 28 inches thick and separated by thin but distinct partings. The second and third constitute a double bearing-in, which seems to be a common feature in the southern portion of this trough. At two feet below the coal is a thin limestone, which rests on 4 feet of shale, overlying a second bed of limestone, the top of which is exposed in the creek. The shale contains a thin layer of iron ore, which occurs in broad, flattened nodules. The quantity is insignificant, but its occurrence is of interest as showing the extended area over which this is an ore horizon.

Within a few rods of this bank, a boring was made in 1845 by Messrs. Sloan and Freeman, beginning at the base of the coal. At the depth of 600 feet, in a heavy sandstone, a flow of salt water was obtained, which led the proprietors to begin the manufacture of salt. But with the brine was associated a considerable quantity of petroleum, which was of unknown nature, and was a serious annoyance, as it remained after evaporation of the brine, and rendered the salt unsalable. Much curiosity was excited by this oil and samples of it were sent to Pittsburg and other places for examination. But no satisfactory information could be obtained respecting it. To rid themselves of this trouble, the owners of the well pushed the boring further, hoping to reach another stream of brine. At the depth of 786 feet a powerful jet of gas deranged the machinery and caused

the loss of the tools, so that the work was abandoned. This is believed to be the earliest "oil-strike" in South-West Pennsylvania. Though thirty years have elapsed since this boring was made, the gas still continues to flow, and so far as can be ascertained from those who have lived in the vicinity for years, the quantity shows no signs of diminution.

No record of this boring was preserved, but at 630 feet, shortly after passing through the great sandstone, a thick coal bed was found. It is sufficiently clear that the sandstone, which is not far from 70 feet thick, is the Mahoning Sandstone, the second or principal oil-rock of the Dunkard creek region, of Greene county, though the interval between it and the *Pittsburg coal bed* is greater than there, being 550 feet here, and only 425 feet there. This boring was made on the crest of a small local anticlinal, through whose influence the *Pittsburg coal* is kept above the creek. A well, bored at a little way further up the stream, but beyond the influence of this axis, failed to obtain any oil.

Along the river below the steamboat landing, the *Pittsburg coal bed* is opened, and the coal extensively mined for shipment by Messrs. Cunningham & Co. In all the openings, the roof division consists wholly of coal and varies from 1 to 5 inches, though at one it is absent. The main clay parting is from 4 to 10 inches. The lower division varies from 7 feet 6 inches to 9 feet, the variations being caused by swelling of the under-clay. It shows no partings except one at 10 inches from the bottom, and that is not persistent. In the upper portion, for 26 inches, binders are numerous, but none of them becomes a parting. The whole bed is mined, and it yields marketable coal throughout. For the most part, the coal is quite free-burning, and near the middle there is an ill-defined bench of good block coal. This portion occasionally contains some pyrites, but the quantity is insignificant. Clay-veins are numerous, but they do not injure the coal. No iron ore has been found here under this bed.

At these works Mr. J. B. Paynter has begun to manufacture coke from the slack. He has erected twenty ovens,

and burns the coal for seventy hours. The coke is compact, and for foundry purposes is quite superior. Mr. Paynter claims that for furnaces it is fully equal to Connellsville coke.

At the tunnel of the Redstone railroad, near the mouth of Redstone creek, the following section is exposed :

1. Debris,	10'
2. Sandy shale,	15'
3. <i>Redstone coal bed</i> ,	1' to 8"
4. Fire clay,	4"
5. Sandy and clay shale,	23'
6. <i>Pittsburg coal bed</i> ,	8'

The *Redstone* appears to be a very fair coal with but little pyrites. At other exposures up the river it is represented only by carbonaceous shale. No. 5 of the section contains vast numbers of impressions of *Neuropteris cordata*. On Redstone creek the *Pittsburg coal bed* is well exposed up to the township line, but the openings examined show no difference from those already referred to. The Fishpot Limestone was seen at one locality, where it seemed to be ferruginous throughout.

On the National road, the *Uniontown coal bed* was seen at the roadside, about a mile from Brownsville. Its blossom is very small and the limestone below, as may be seen by referring to the long section first given, is thin. The blossom of the *Waynesburg coal bed* was observed near the stone quarry, but no opening was found until near the township line, where just south from the pike the coal is mined by Mr. J. L. Bird. It is in three benches, 18, 17, and 25 inches thick, with partings 1 and 5 inches. The top layer of coal is very poor and does not burn to ashes, unless first broken into small fragments. As a whole the bed yields inferior coal, which can be used well enough on grates, but proves an inconvenient fuel in stoves.

The overlying sandstone is quarried here as well as on the pike about half a mile west. It contains a good deal of iron, which renders the lines of deposition distinct, and exposes the concentric structure of a large portion of the rock. The stone varies in color from light gray to bluish gray. It is coarse, micaceous and contains small grains of feldspar,

which yield on exposure and leave the surface rough. This is said to be a good building stone. When first taken from the quarry it is soft, but in time becomes hard.

16. LUZERNE TOWNSHIP, OF FAYETTE COUNTY.

This lies within a great bend of the Monongahela river, and adjoins Brownsville, Redstone, and German townships. The axis of the Lisbon (Irwin) synclinal passes altogether south-east from it, so that the whole township is on the western side of the trough, and the general dip of the rocks is toward the south-east. A slight local anticlinal crosses Dunlaps creek at a mile from the river, but it cannot be recognized away from that stream. The exposed section reaches from 50 feet above the *Washington coal bed* to about 30 feet below the *Pittsburg*. The latter bed is available along a short line on the river, from opposite Millsborough to below Frederick, and on Dunlap's creek to a distance of nearly two miles from the river. The *Waynesburg coal bed* is available throughout the greater part of the township, but the *Sewickley coal bed*, which on the opposite side of the river is of workable thickness, is wholly concealed.

Along the whole river line, the *Waynesburg coal bed* is within easy striking distance, and is worked at many localities as far down as opposite the mouth of Ten-Mile creek. The general character of the bed is shown in the following sections, of which the first was obtained at Mr. Woods' bank, about a mile south-west from Heisterburg, and the second at an opening on the Telegraph road, three-fourths of a mile from the river:

1. Waynesb'g sandstone seen, 20'		15'	
2. Clay shale,	3"	8'	
3. Coal,	3"	1'	
4. Clay,	3"		1" to 2"
5. Coal, 2'		1'	7"
6. Clay,	2" to 10"	2' to 10"	
7. Coal, 3' to 4'		3'	

Along this line the sandstone varies from flaggy to compact, usually showing the latter character toward the base. The shale at the second opening is crowded with fossil leaves; and contains many nodules of clay-iron stone. On the whole,

the coal is inferior, but the river banks seem to have a better reputation than those in the interior, as coal from them is hauled all the way across the township, though the same bed is opened on the east side. At Mr. Woods', the coal is 240 feet above the river, and shows an extreme dip of 80 feet per mile south-east. The distance to the *Pittsburg* at any point, where it is below the surface, may readily be ascertained throughout this region, for the interval between it and the *Waynesburg coal bed* is not far from 350 feet, from Brownsville to the State line along the river.

Toward the mouth of Ten-Mile creek, the *Waynesburg* out-crop recedes from the river, the hills not being high enough to catch it, and the *Pittsburg* comes up from under the surface. Thence, for nearly four miles, the latter coal bed is accessible, and is exposed at Millsborough as a black band in the river bank. Few openings were found on this side of the river, and these present a section varying little from the following:

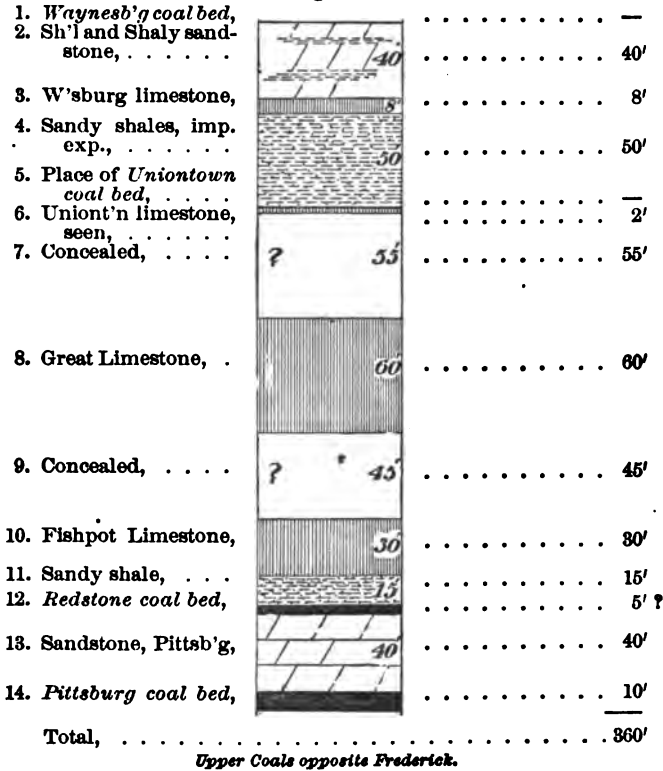
1. Pittsburg sandstone,	40'		} 10' 7" to 8' 11"
2. Roof division,	1'	8"	
3. Main clay,		9" to 11"	
4. Lower division,	8' to 6' 6"		

Further down the river, below the great curve, the flow is toward the east, and the rocks go under so that at the mouth of Rush run, the *Pittsburg* is not less than 40 feet below the surface. As the strata come down, it is seen that the Great Limestone is even thicker than is given in the section above, being fairly exposed at one locality to the thickness of 70 feet. The blossom of the *Sewickley coal bed* was observed at several places, but the coal is nowhere exposed so as to admit of measurement. On the opposite side of the river, near lock No. 5, it is 3 feet thick, and at a mile above Brownsville it is 6 feet 2 inches, with 2 feet of black sandy shale at 8 inches from the bottom. At lock No. 5, the *Pittsburg coal bed* is barely 15 feet below the dam.

The *Redstone coal bed* is occasionally exposed, and is represented by a mass of carbonaceous shale, associated with a very thin coal bed. The following is an approximate sec-

tion from the *Waynesburg* to the *Pittsburg*, as far as exposed, on the road leading up from the river opposite Frederick :

Fig. 28.



Along Dunlap's creek, the *Pittsburg* does not go under until Mr. I. Allen's property is reached. Several openings were examined, but as they differ in nowise from others seen further down the creek, in Brownsville township, it is unnecessary to repeat the details here. On the same creek, the *Waynesburg* coal bed is available in the hills from the township line up to a mile above Merrittstown, where it passes under the stream. No mines were seen on this side below Merrittstown, but there the coal has been opened by Mr. A. Struble, at whose bank the section is :

1. Shattered sandstone,	10'		
2. Coal,		9"	
3. Clay,		2"	
4. Coal,	2' to 1'	4"	
5. Clay,	2' 2" to 1' 1"		
6. Coal, seen,	2' 3"		

7' 4" to 5' 7"

No. 6 is said to reach 3 feet. Other openings occur in the neighborhood, and are similar to this. The coal shows its ordinary character, and contains much ash and sulphur.

On the road leading from Merrittstown to Bridgeport, the Waynesburg Limestone is seen in the road just outside of the former village. The *Little Waynesburg* rests on it, represented by a dark fissile shale. From this point to where the road descends the hill to Bull run, there are no exposures, but at that locality the following section was obtained :

1. Limestone,	3'
2. <i>Uniontown coal bed</i> ,	Blossom.
3. Limestone and sandstone,	40'
4. Great limestone,	60'
5. Sandy shale,	20'
6. Fishpot limestone, to the run,	10'

No. 1 is the blue laminated limestone, frequently found overlying the *Uniontown coal bed*. In No. 3, the Uniontown Limestone is partly exposed, but its thickness cannot be made out. The *Uniontown coal* seems to be about 2 feet thick, and remains in sight along the road to near the school-house. The *Sewickley coal bed* should be found between Nos. 5 and 6, but there is not even carbonaceous shale to represent it.

On the telegraph road, about two miles from Merrittstown, the *Waynesburg coal bed* is mined by Lewis Knight and George Garwood. At their openings, the bed resembles the sections already given. Along the Merrittstown and Heistersburg road the same bed is mined, and an opening was seen on the road from Heistersburg to McClellandtown. Just beyond Heistersburg, the *Washington coal bed* is exposed in the road, and at half a mile further west, near the first cross-roads, the blossom of the *Waynesburg "a"* is seen at 70 feet. Above the *Waynesburg*, resting on sandstone, and underlying Limestone *1a*, on a little

run half a mile beyond, there is a rude opening in the *Waynesburg* showing 5 feet 4 inches of coal, in three divisions. In the lane leading to Mr. Gibson's house, the *Waynesburg* "a" is again exposed, this time making such a blossom that its thickness cannot be less than 3 feet. The lower bed is mined by Mr. Porter, below the road, at three miles from Heistersburg. Throughout the whole distance, from where it crosses the telegraph road to where the Frederick road leaves it, this road is for the most part in the *Waynesburg* Sandstone, and the *Waynesburg coal bed* is easily accessible, in every run or hollow, on either side. Beyond the latter point, the road soon falls below that coal, and as it approaches the river, exposes the lower rocks.

On the road to Frederick, the *Waynesburg* and *Waynesburg* "a" are frequently exposed, and the former is rudely mined. At one mile from the river, the *Waynesburg* is seen for the last time.

17. GERMAN TOWNSHIP, OF FAYETTE COUNTY.

This lies along the river line, south from Luzerne and west from South Union and Georges. The Lisbon (Irwin) synclinal passes through it, crossing Middle run near the school-house, and reaching the river about one mile from the mouth of that stream. The Saltsburg anticlinal enters the township with the Uniontown and McClellandtown road, and passes out close by the north-east corner of Nicholson. The exposed rocks reach from 60 feet above the *Washington coal bed* to 20 feet below the *Pittsburg*, but along the central line of the trough the hills catch about 100 feet more of the higher rocks, which are wholly concealed.

Along Cats run, which forms in part the southern boundary of the township, the *Pittsburg* and *Sewickley* are worked on Mr. Poundstone's property, where they are 98 feet apart, and the latter is 5 feet 1 inch thick. Ascending the run and taking the road by the distillery to Masontown, one finds the *Pittsburg coal bed opened*, the exposure being:

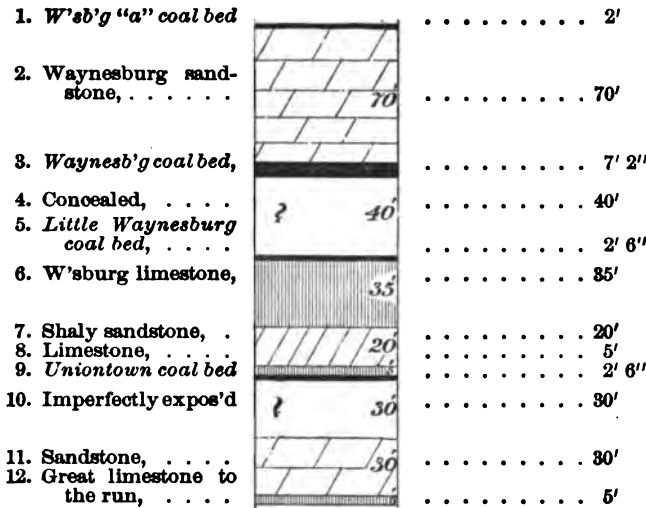
16—KK.

1. Carbonaceous shale,	8'	
2. Coal,		1" to 2"
3. Sandy shale,	8'	
4. <i>Pittsburg</i> coal bed—		
Roof division,	5' 5"	} 13' 3"
Main clay,	10"	
Lower division,	7'	

On the other side of the river the *Redstone* coal bed is 20 feet above the *Pittsburg*, so that the little coal No. 2 may be regarded as belonging to the *Pittsburg*. Still the *Redstone* is so often represented by such a combination as Nos. 1 and 2, that it is by no means impossible that this is that coal. The roof division of the *Pittsburg* shows two benches of coal separated by 15 inches of clay, the upper being a mixed mass of coal and clay 3 feet 6 inches thick. The lower division shows vertical planes of fissure which render working quite easy. In the upper portion of No. 3 there are many impressions of plants. Above this section there are no exposures for 145 feet, when the Great Limestone is seen, and its outcroppings remain in sight until the main street of Masontown is reached.

Along the road from Masontown to McClellandtown the blossom of the *Waynesburg* coal bed is seen before reaching the first fork and at a little distance further the *Waynesburg* "a" is exposed, 2 or 3 feet thick, and resting on the *Waynesburg* Sandstone. At about 70 feet below it, the *Waynesburg* is again in the road, and in an adjoining field it is mined by Mr. T. A. Hoover. At this opening it is separated from the overlying sandstone by a variable clay, and shows three benches of coal, respectively 16, 26, and 30 inches thick. The intervening layers of clay are 2 and 5 to 20 inches. The lower clay varies at the expense of both layers of coal, but chiefly at the expense of the upper. As usual this coal is reported to make a strong fire but to leave much ash. Pyrites occurs in lumps, but, for the most part, is distributed in binders, and the quantity is considerable. From this opening a little stream flows to Browns run, on which the following section was obtained:

Fig. 29.



Upper Coals on Brown's Run.

The *Little Waynesburg* coal bed is fairly exposed in the run and appears to be about 2 feet 6 inches thick. It has been mined by stripping, and proved to be a very fair fuel. The *Waynesburg* Limestone is in two divisions separated by 10 feet of calcareous sandstone. The upper division is in layers, 15 to 18 inches thick, all of which yield good lime, but the second and third, descending, are the best. The third contains much spar, which seems to replace a branching coral like *Syringopora*, and gives the rock a birdseye appearance. This layer is said to burn into white lime.

At a little distance below this, on the run, the *Uniontown* coal has been mined by stripping, and a rude opening was seen which has long been deserted. No exact measurement could be made, but the bed seems to vary little from 2 feet 6 inches, and shows a thin parting of clay at one foot from the bottom. In quality, the coal is said to be somewhat better than that from the *Waynesburg*, but the bed is too thin to repay working. Below it a few feet there is an imperfect exposure of limestone, but the thickness of the bed is not shown.

On Brown's run the *Pittsburg* comes up near the junc-

tion of the two forks and soon runs out in the hills. A space of several miles along the south fork is bordered by hills too low to catch the coal, but within half a mile of Georges township the bed, now dipping south-east, is caught in some hills both north and south from the stream. On the north fork an opening was found on Capt. I. P. Kendall's property which shows :

Roof division,	3' 4"	} 12' 7"
Main clay,	1" to 5"	
Lower division,	9' 1"	

The roof shows two layers of coal, 1 foot and 4 inches, separated by two feet of clay, which contains many thin streaks of coal. At two feet below the coal there is an irregular limestone resting on a clay containing nodular iron ore. This deposit has not been explored, but fragments of the ore seen show that it is of good quality. The coal has been coked and yielded a compact article, which proves to be excellent for foundry purposes. Ascending the stream, numerous openings were observed, all of which resemble that of Capt. Kendall; but the bed rises rapidly, and in less than a mile is almost at the summits of the higher hills alongside the run, and at Mack's (formerly Messmore's) mill it is 260 feet higher than at Capt. Kendall's bank. About half a mile south from the run here, are two openings, one belonging to Mr. Mack and the other to Mr. Newcomer, the latter of which shows :

Roof division and main clay, 5 feet 10 inches; lower division, 8 feet 7 inches.

Immediately above it is laminated sandy shale. The roof division consists of ten inches of coal resting on 5 feet of clay, in which there are some laminæ of coal. The adjoining bank differs only in that the clay parting is better defined, being 10 inches thick with 8 inches of coal resting on it. The total of coal in the roof here is 20 inches. Eastward from this the coal soon passes out of the hills, and no further openings were seen along the run within the township. For the most part the rocks below the coal are concealed, and a section of the Lower Barren Series cannot be made out.

Returning now to the McClellandtown road, one finds immediately north from Brown's run Mr. Gilmore's opening in the *Waynesburg*, which shows:

1. Sandy shale, 10'
2. Clay shale with streaks of coal, 4'
3. *Waynesburg coal bed*, 7' 4"

The sandy shale contains numerous impressions of leaves, some of which are very fine. The coal is in three layers, with an extreme thickness of 5 feet 2 inches. The top layer is 1 foot thick, and poor; the lower parting varies from 18 inches to four feet, and chiefly at the expense of the bottom layer of coal. It shows occasional strings of coal which come down from the bench above. In the road beyond this bank, the *Waynesburg sandstone* is exposed, the lower portion being compact, while the upper part is shaly.

At a little way north from the road, and near Mr. A. Struble's house, the *Waynesburg "a"* is seen in the road, and not far beyond his house the blossom of the *Washington coal bed* is shown in the road. On the river bluff, Mr. Struble has opened the latter bed. There, the following is the section:

1. Lower Washington Limestone, Fragments.
2. Clay and iron ore, 4'
3. Clay, 1' 6"
4. *Washington coal bed*, 5' 8"

The coal is in four layers, 4, 13, 11, and 14 inches thick, separated by layers of clay, 15, 6, and 5 inches. The coal is hard, very compact, and has tremendous heating power, but burns away quickly and leaves a bulky ash. Mr. Struble maintains that sulphur is present in smaller quantity than in coal from the *Waynesburg*. As the coal is open-burning, some have supposed that it might be employed as a furnace coal, but the proportion of ash is fatal. The Lower Washington Limestone is seen only in fragments, and no estimate of its thickness can be made. The ore below it is 2 feet 6 inches thick. Samples were taken for analysis, and the results will be found in another chapter. The quantity is sufficient to justify drifting if the quality be good. The coal and ore are caught in a number of hills

within a short distance from this locality. The rocks immediately underlying the section are concealed.

The blossom of the *Waynesburg* "a" is seen at its proper place below the *Washington* and at 120 feet below the latter the *Waynesburg* Sandstone forms a vertical cliff, 30 feet high. The *Waynesburg* coal bed is directly under this rock, and is mined by Mr. Struble. It has a total thickness of 6 feet 9 inches with 5 feet 11 inches of coal. The partings are quite thin, only 2 and 10 inches. The coal is said to do very well in grates, but is so sulphurous and dirty as to be an inconvenient fuel for use in stoves. The interval between the *Washington* and *Waynesburg* beds is 150 feet.

Following the McClellandtown road, one sees the *Waynesburg* "a," the *Waynesburg*, and the *Waynesburg* Limestone before reaching the little run which flows past Mr. Weltner's house. The road soon rises above these coals, and the *Waynesburg* is not seen again until near the Presbyterian church on the road from the school-house to Brown's run. At McClellandtown, the *Sewickley* coal bed is exposed in the road and the *Pittsburg* is mined just south from the village. East from the village, the *Sewickley* remains in sight for nearly a mile, and at the first cross-road the Fishpot Limestone is quarried to procure lime for agricultural purposes. South from this quarry the *Redstone* coal bed is exposed, resting on the Redstone Limestone which here is yellow and very thin. In an adjoining field the *Pittsburg* is mined by Mr. Hostettler.

Still following the road, which is now the Uniontown and McClellandtown road, one finds frequent openings in the *Pittsburg*. To the township line, where the Saltsburg anticlinal crosses, that coal bed is caught in the hill-tops in patches of from two to twenty acres. The roof is thin but sound, and the coal is clean and good. The rate of dip has materially diminished and the coal is available everywhere. On the road, Mr. Coffman's is the first opening in this bed, which there shows :

Roof division, 3 feet 10 inches ; main clay, 1 foot ; lower division, seen, 7 feet.

The roof is topped with one foot of carbonaceous shale and contains 8 inches of coal in three layers. The top of the lower division, for 8 inches, is poor and slaty. East from this the coal is opened by Mr. Sapper, Mr. J. H. Poundstone, and Mr. G. Poundstone along the road, and by Mr. Newcomer, south from it. The last opening is high up on the axis, and is the last until just beyond the township line, where Watson's knob, on the crest of the axis, rises high enough to catch the coal.

Northward from this road, the *Pittsburg coal bed* is mined on the waters of Dunlap's creek, in the eastern portion of the township. The most southerly exposure here is on the lands of Mr. J. Poundstone and Mr. C. Dearth. Near this the coal is mined by Mr. L. Campbell, whose opening shows about 8 feet of coal in the lower division, the roof being concealed. Beginning at 20 feet below the coal the following short section was seen :

- | | |
|--|-------|
| 1. Ferruginous carbonaceous shale, | 2' 6" |
| 2. Limestone, | 6" |
| 3. Drab shale with ore, | 5' |
| 4. Limestone, seen, | 8' |

The black shale No. 1 is quite ferruginous, compact, and heavy, so that it bears close resemblance to black-band ore. It is of general distribution but is worthless. The ore of No. 3 is nodular and in considerable quantity, but the nodules are too much scattered to be of any value. On the adjoining property the coal is mined by Mr. Woodward, near whose house it goes under the surface, at somewhat more than a mile and a quarter from the out-crop.

On the road leading southward from this point the *Redstone coal bed* is exposed and is represented by a mass of compact carbonaceous shale 4 or 5 feet thick, which rests directly on the yellow Redstone Limestone. The rocks rise with this road, and this stratum remains in sight to the forks. Between these points the top of the *Pittsburg* is reached near Mr. Gore's house. From the forks, the road rises rapidly, so that at its junction with the Uniontown and McClellandtown road the Fishpot Limestone is exposed.

On the road from McClellandstown to Heistersburg there are no exposures until in the immediate vicinity of Middle run, where the *Waynesburg* "a" and the *Washington* (?) are exposed by their blossoms. At a short distance down the run, the *Waynesburg coal bed* is reached, and near Mr. Johnson's saw-mill it has been mined by stripping. At Mr. S. Haney's opening, below the school-house, the section is as follows:

1. Clay shale,	15'
2. Coal,	1' 1"
3. Clay,	2"
4. Coal,	2' to 1' 8"
5. Clay,	1' 2" to 1"
6. Coal,	2' 4" to 2' 6"

No. 1 shows many good impressions of plants and contains numerous nodules of lean iron ore. It is not persistent, for many openings along the run show the coal in contact with the sandstone. In this opening, No. 5 is seldom more than 2 inches thick, but in the others it averages one foot. The coal contains a prodigious amount of ash and sulphur, so that it is exceedingly injurious to stoves, and those who use it do not regard it as a desirable fuel.

On the Heistersburg road, leading northward from the run, at the school-house, the *Washington coal bed* was mined many years ago, but the opening has been deserted for so long a time that no information can be obtained respecting the bed, further than that it is 5 feet thick, and yields very bad coal. The interval to the *Waynesburg* is 140 feet. The *Waynesburg* "a" is seen at 80 feet above the latter, and unaccompanied by limestone. Along the little run flowing by this road, the *Waynesburg coal* is available for somewhat more than a mile, and at its head is seen in the forks of the road by Mr. Higginbotham's house. Thence to the township line the surface is well above the coal.

18. NICHOLSON TOWNSHIP, OF FAYETTE COUNTY.

This township lies along the Monongahela river, south from German and north from Springhill. The Saltsburg anticlinal enters very near the north-east corner, crosses the high

summit between Croziers run and Jacobs creek, about two thirds of a mile west from Mr. Crozier's house, on the former stream, and passes into Springhill across Georges creek, near Crow's mill. The section reaches from 350 feet below the *Pittsburg coal bed* to about 200 feet above it. That coal bed is accessible in the greater part of the township, but in the south-eastern portion it has been almost wholly eroded from the sides and crest of the anticlinal. Along Georges creek, the southern boundary of the township, it reaches little more than a mile from the river, and thence to the line of Georges township, it does not approach within less than half a mile of the creek. In the east and north-east portions, the coal has not been wholly eroded, and along one line is continuous over the crest of the axis.

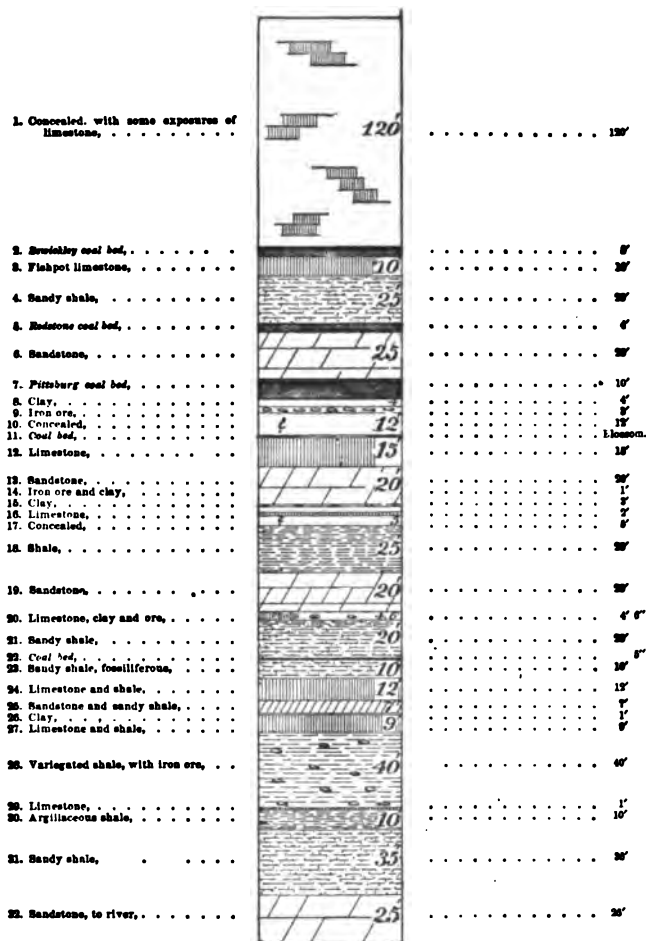
At New Geneva, the section represented by Fig. 30, was obtained, beginning at the high knob on Judge Crow's farm, back from the village.

The concealed portion, No. 1, is seen only on Judge Crow's farm, and some high hills in the immediate vicinity. It shows some fragmentary exposures of the Great' Limestone. The *Sewickley coal bed* shows its blossom on the roads, and, as ascertained in a well, is 5 feet thick. No openings in it occur here. The Fishpot Limestone is yellow, and too ferruginous to be of any value. The *Redstone coal bed* is represented by 4 feet of bituminous shale, containing numerous thin streaks of bituminous coal, and some of cannel. On the river hill, by New Geneva, the *Pittsburg coal bed* is about 300 feet above low water, and thence along the river bluff the openings are numerous down to the northern line of the township. At most of these the roof seems to be an irregular mass of clay and coal, 3 to 4 feet thick, while the lower division is not far from 8 feet 6 inches, though at some pits it reaches 9 feet. The coal is of excellent quality, and closely resembles that obtained in the coke basin.

Below the coal, and separated from it by only 4 feet of clay, is a bed of iron ore, occupying the same relative position as the Oliphant Blue Lump, but differing from it in that it this is the ordinary gray carbonate, while that is a very hand-

some kidney ore. This deposit is very persistent along the river face from New Geneva to below the mouth of Cat's run, the northern boundary of the township, where the coal goes under the river. On Georges creek it is finely exposed on Judge Crow's property, where it is very compact, 2 to 3 feet thick, and evidently a very good ore. The quantity is enormous. In the interval, No. 10, the whole of the Oliphant series has been discovered, since the locality was examined by me.

Fig. 80.



Section at New Geneva.

The ore, No. 14, was seen at two points on the river bluff, somewhat more than a mile below New Geneva. It averages about 8 inches, and is nodular, but the nodules are closely packed, so as to form an almost solid layer. It is a handsome carbonate, and should be a good ore. Further down the river a nodular limestone ore occurs, embedded in clay, at 85 feet below the *Pittsburg coal bed*, and a little above the sandstone No. 19. The exposure is not satisfactory, and the ore is not rich. It was not observed elsewhere.

The Sandstone, No. 19, is thoroughly persistent, and is doubtless the same with that which Prof. Lesley has called the Connellsville Sandstone. On the river front the rock has a shattered surface, but on Georges creek it is very compact, and for a long distance forms an imposing cliff. Here its top is only 70 feet below the coal, whereas on the river hill it is 90 feet. On Judge Crow's farm, about a mile up the creek, there underlies this sandstone a compact clay with much iron ore, which passes down into an almost solid layer of nodular ore about 2 feet 6 inches thick. The nodules, in some instances, weigh 80 pounds, and the ore is thought to be very good. On the river bluff, there is at this horizon limestone with clay and ore, the whole forming a layer 4 feet 6 inches thick. The ore is nodular, closely resembles that of No. 14 in general appearance, and is evidently much cleaner than that seen on Georges creek. Analysis shows it to be of very excellent quality.

The limestone, No. 27, is said to contain 10 per cent. of iron, and is regarded as an excellent flux, for which purpose it has been shipped. It is persistent along Georges creek. No. 28 is a mass of variegated clay, without bedding. Midway it contains much lean nodular ore, which, eventually may be of some value, as the layer of ore is more than 2 feet thick, and the nodules are compactly arranged. All these ores seem to be persistent along the river, to where they disappear under the stream.

The ore in the clay, No. 28, is not exposed at any locality examined on Georges creek; but at Crow's mill, about two miles and a half due east from the mouth of the creek, there is a bed of ore from 8 to 14 inches thick, and not far from

350 feet below the *Pittsburg coal bed*. The exact interval cannot well be determined, owing to the distance from any exposure of that coal. At twelve feet below the ore is a black fossiliferous limestone or calcareous shale. The ore is easily traced for more than a mile along the creek. Forty years ago it was mined and taken to Fairchance furnace where it is said to have proved good, though inferior to the Blue Lump. The results of analysis do not confirm this statement. Twenty-five feet above this ore, at Crow's mill, the blossom of a thin coal bed was seen, and at 55 feet there is an ore. Below the last is a sandstone which may be the No. 32 of the New Geneva section.

The road from New Geneva to Smithfield passes along the dividing ridge, between Georges and Jacobs creeks, until it reaches the Presbyterian church, nearly four miles from the former place, where it leaves the ridge and descends to Yorks run, a tributary to Georges creek. Along the ridge it is constantly above the *Pittsburg coal*, which is accessible on both sides, while the blossom of the *Sewickley coal bed* is frequently exposed in the road. At the church it reaches the coal, which is rudely mined near by at Mr. Monahan's bank, and is said to have the following structure:

Roof division, 3 feet; main clay, 1 foot; lower division, 8 feet.

The opening is so rude that nothing can be ascertained from it. This is the last opening near the Smithfield road within the township. The extensive erosion by Yorks run, War Branch run, and Georges creek has removed the bed almost wholly from both sides of the axis for more than three miles along this road, and for the same distance north and south. Two small patches remain on the summits of high hills, south from this road, one on each side of Yorks run, and about two thirds of a mile north from Georges creek. Within the denuded area, the Lower Barren rocks are imperfectly exhibited. At 140 or 150 feet below the *Pittsburg coal bed*, and just east from Yorks run on the Smithfield road, a bed of iron ore 6 inches thick was seen, which is not represented in the section obtained at New

Geneva, nor was it observed elsewhere. It resembles that seen at Crow's mill.

At the school-house near Yorks run, a road turns off to the north. Along this for some distance the hills are too low to catch the *Pittsburg coal bed*, but at a little more than a mile from the school-house, and near the first fork in the road, the coal is reached almost at the crest of the axis. Not far west from the run the coal is mined by Mr. Sturgiss, near Mr. Zarley's house, where the bed is dipping eastward, and is about 100 feet higher than at an opening near Smith-field. Here the roof is 3 feet, and contains but a small proportion of coal. The lower division is exposed only to the bearing-in bench, which is 5 feet from the main clay parting.

On an east and west road passing north from this bank, another opening was seen half a mile west north-west from the last, which is dipping westward. The crest of the anticlinal passes between these openings and somewhat nearer the latter, as it is 10 feet higher than the former. At a little distance further west, there are several openings on the road leading by the Presbyterian church already referred to. One of these, belonging to Mr. Walters, is 80 feet lower than the last mentioned, so that the north-west dip is quite rapid, though by no means so sharp as it is further north. Turning northward here, one soon comes to the bank belonging to Messrs. J. R. and J. H. Core, where the structure of the bed is shown as follows :

1. Roof division,—

Coal,	1' 6"	}	6' 8"	}	16' 2"
Clay and coal,	4'				
Slaty coal,	4"				
Clay,	6"				
Coal and clay,	4"				
2. Main clay partings,	10"				
3. Lower division,	8' 8"				

The total of coal in the roof division is barely 1 foot 10 inches. The coal of the lower division is good and contains but little pyrites, for the well at the house near by stops in the middle of the bed, and the water has but a barely perceptible inky taste. Under the coal there is no exposure,

but there is evidence that iron ore is present at about 8 feet below it. No examination has ever been made on or near the crest of the axis to determine to what extent this ore is present.

The *Redstone coal bed* is exposed in the road near Mr. Core's house, and is a richly carbonaceous shale, 3 feet thick, which contains much inferior cannel. It is only 14 feet above the *Pittsburg*. The whole mass burns well, but leaves so much ash as to be worthless. Resting on it is a bed of shale, which contains numerous impressions of leaves, beautifully preserved, and belonging chiefly to *Neuropteris*, *Alethopteris* and *Sphenophyllum*. The *Sewickley coal bed* is imperfectly exposed in the road, at 65 feet above the *Pittsburg*, and rests on the Fishpot Limestone. It seems to be only a carbonaceous shale, but the out-crop of this bed often presents this appearance when the coal itself is of superior quality.

Toward Masontown, on this road, the *Pittsburg coal bed* is again seen at half a mile beyond Jacobs creek. Along that stream, it is available to the river, and at several localities a valuable deposit of iron ore is shown at 7 feet under it. On the ridge between Jacobs creek and Cats run, the Great Limestone is imperfectly exposed near the Mennonite chapel, and remains in sight to the head of Freds run, where Mr. Woolsey mines the *Sewickley coal bed*. The exposure there is:

1. Laminated sandstone,	15'	} 5' 8"
2. Coal,	3'	
3. Parting,	1"	
4. Coal, seen,	2' 2"	

This is an excellent coal, and is said to be preferable to that from the *Pittsburg* for domestic use, though it contains rather more ash and sulphur. It does not burn away so rapidly, and produces a stronger and more constant heat. The same bed is mined by Mr. J. Y. Provence further down the run, and is there 65 inches thick, with an ill-defined parting at 39 inches from the top. The Fishpot Limestone is 15 feet below it. The *Redstone coal bed* is shown by its blossom at 45 feet below the *Sewickley*, the distance from the latter to the *Pittsburg* being about 90 feet.

Near the mouth of the run, the *Pittsburg coal bed* is mined by J. Y. Provence, H. L. Ross, and E. W. Walters. At Mr. Provence's bank the roof shows 18 inches of coal, resting on 4 feet of clay, which includes the clay parting. The top bench of the lower division is 4 feet 6 inches thick, and the bearing-in bench is single. Just above this opening the whole bed is well exposed at a fall in the run, and the lower division is shown to be more than 9 feet thick. At Mr. Walters' opening the bed shows:

Roof division, 3 feet 11 inches; main clay, 2 feet; lower division, 8 feet 2 inches.

In the roof the amount of coal is barely 18 inches. The whole of the lower division is said to be marketable. Below the coal, the following is the succession:

1. <i>Pittsburg coal bed</i> ,	14'
2. Clay,	1' to 2'
3. Limestone,	2'
4. Clay and iron ore,	3'
5. Clay,	3'
6. Nodular ore,	2' 6"

The ores, Nos. 4 and 6, are obtained by stripping in the bed of the run, and after roasting are shipped to Wheeling, where they are worth \$3 75 per ton. These ores are found all the way to Cats run, where an additional layer is exposed near the distillery, at 6 feet below No. 6 of the section. It seems to be somewhat inferior to the others, and occurs in lenticular nodules.

CHAPTER XII.

WESTMORELAND COUNTY.

19. MT. PLEASANT TOWNSHIP, OF WESTMORELAND COUNTY.

This is the southern township along the west face of Chestnut hill, and adjoins Fayette county, Jacob's creek being the boundary for a considerable distance. It lies for the most part within the Blairsville trough, and the section extends from the *Waynesburg "a" coal bed* to the Umbral Limestone.

The western outcrop of the *Pittsburg coal bed* enters this township from Unity, at somewhat more than a mile from the Hempfield line, and crosses Sewickly creek near Fisher's mill. Thence it follows a rudely east course to within half a mile of the Hempfield line, where it is turned southward, and within two miles passes out of the township. The eastern out-crop enters at the south-west, from East Huntingdon, and is carried southward to Jacob's creek. There it turns, and follows a very regular north-east course to the line of Unity township. For a long distance its direction is determined by the valley of Brush run, and at the north, by the two forks of Sewickley creek.

In the vicinity of Mt. Pleasant, on the eastern crop, the openings are numerous and extensive, that being an important center of coking operations. This interest has been so fully discussed in the coke report, that no reference to it is necessary here. The coal out-crop crosses the pike about two miles east from Mt. Pleasant, and within three miles north from that point is mined by Mr. Barnhart, Mr. J. J. Hunter, and Mr. J. L. Lemmon, at whose openings it shows:

1. Shale,	5'
2. Roof division,	4'
3. Main clay,	1'
4. Lower division,	8' 3 $\frac{1}{2}$ '
} 18' 3 $\frac{1}{2}$ '	

The roof division is not fully exposed at any locality, but seems to consist of inferior coal broken up by numerous thin partings of hard clay. The lower division shows four benches, 35, 30, 3, and 30 inches thick. Those above the third, or "bearing-in," are made up of prismatic, tender coal, but the bottom is harder and somewhat pyritous. Half a mile south from Sewickley creek, Mr. Rambaugh's opening shows a different structure, as follows :

1. Roof division—			
Coal, with thin slates,	2' 3''	} 4' 10''	
Carbonaceous shale,	1' 6''		
Coal,	2''		
Shale,	6''		
Coal,	5''		
2. Main clay parting,		8''	} 12' 3''
3. Lower division—			
Coal,	1' 8''	} 6' 9''	
Bony coal,	5''		
Coal,	2' 6''		
Coal and partings,	6''		
Coal, seen,	1' 8''		

As the coal below the bearing-in usually varies little from 30 inches, the lower division is probably one foot thicker than is given above. A well-marked parting was seen at 10 inches below that bench. The character of the coal is the same with that observed along this whole line.

On the western out-crop the bed shows a similar structure, the section at Mr. J. Boyer's opening being :

Roof division, 4 feet 2 inches ; main clay, 1 foot ; lower division, 7 feet 6 inches ; total, 12 feet 6 inches.

In the roof there are 42 inches of coal, and the main clay varies from 2 inches to 1 foot. The coal above the bearing-in is 50 inches and shows a thin parting at 22 inches from the top. Openings are numerous, and those belonging to Mr. Kuhns, Mr. Love, Mr. Boyers, and Mr. Campbell have substantially the same section, and the coal varies but little in quality.

The dip is so rapid in this narrow basin, and diminishes so irregularly toward the axis of the synclinal that sections are obtained with the utmost difficulty, and when obtained the intervals are of very uncertain value. Occasionally there are exposures for some distance along a road closely

following the direction of the strike. Such a series was found on the road leading from Mt. Pleasant to Pleasant Unity, and the following section was made out :

Fig. 31.

1. Sandy shale,	30'	30'
2. <i>Waynesb'g</i> coal bed,	5'	5'
3. Shale,	20'	20'
4. <i>Lit. W'y'sb'g c'l</i> bed,	6'	6' (?)
5. <i>W'y'sb'g</i> limestone,	40'	40'
6. Imperfe'ly exposed,	—	—
7. <i>Unionto'n</i> coal bed,	8'	8'
8. Limestone,	10'	10'
9. Concealed,	7'	7'
10. Limestone,	30'	30'
11. Sandstone, seen,		

Pleasant Unity Road.

The *Waynesburg* coal bed has been mined on Mr. Louck's property, five miles from Mt. Pleasant. It is fairly well exposed on the road about half a mile further south. It has been opened by Mr. Andrews near the Presbyterian church, and a deserted opening was seen near Mr. S. Warden's house on the line between this and East Huntingdon township. At all exposures it yields an inferior coal and the bed is broken up by layers of clay, as well as by thin slates. It occurs in all the higher hills along the central line of the trough. At a little way south-east from Mr. Louck's, there seems to be a thin coal bed at 35 feet above the *Waynesburg*, which probably represents the *Waynesburg* "a."

The *Little Waynesburg* is very thin, but is clearly a coal bed, and not merely black shale. Its blossom is seen in the road south from Mr. Louck's, and twice again before reaching the Presbyterian church. The *Waynesburg* Limestone is exposed along the roads only in fragments, but at one locality, north-west from the Presbyterian church, it has been opened, and the thickness was ascertained to be 6 feet. Its quality is excellent. At St. Paul's church, within a mile of Pleasant Unity, a limestone is seen 4 feet thick, and 130 feet above the lower division of the Great Limestone. In all respects it resembles the *Waynesburg*

Limestone, as shown further south in the township, and has, at 30 feet above it, a mass of black coaly shale badly exposed, which probably represents the *Waynesburg coal bed*. At 30 feet above the coaly shale is another limestone, which may possibly be Limestone Ia, of the Washington County Group. At no place is the interval between the Waynesburg Limestone and the *Uniontown coal bed* fully exposed. Near Mr. J. Rambaugh's house, the lower portion for 12 feet is sandstone.

The *Uniontown coal bed* was first seen in the road near Mr. J. Rambaugh's house, where it is little more than 1 foot thick, if the blossom may be taken as a guide. It is concealed at all other localities, excepting one in the western portion of the township—at less than half a mile north-east from Mr. Warden's house.

The upper, or Uniontown division, of the Great Limestone is double, both divisions being shown at the Presbyterian church. It remains in sight for a considerable distance along the Greensburg road. The lower portion of it is quarried both north and south from Mt. Pleasant, and yields a lime of superior quality, which is used for building purposes. The rock itself is used at Charlotte furnace, as a flux. Its thickness varies, being 7 feet north from the borough, and from 12 to 15 south from it. The exposures south from the borough are not fully satisfactory, but in all probability the two portions shown in the section are there united, and the apparent increase in thickness is the result. This limestone is absent from the northern part of the township. Below it is a sandstone, which reaches to the lower division of the Great Limestone. The latter is nowhere exposed in detail, but in the shaft sunk near Mt. Pleasant by Messrs. Duncan & Bro., it is said to be 20 feet thick. Its fragments are collected, and burned for lime along the pike east from Mt. Pleasant. In the northern part of the township, its thickness is 20 feet.

The blossom of the *Sewickley coal bed* is shown at several places along the south-eastern side of the trough. In the Duncan shaft, this bed was found at 120 feet above the *Pittsburg coal*, and 18 inches thick. At all exposures the

bed is thin, and no openings were found anywhere. In the northern portion of the township, near the Unity line, the thickness is evidently greater. But no openings have been made to determine either thickness or quality.

The *Redstone coal bed* varies from 2 to 4 feet, and is commonly known as the "4 foot vein." Its blossom is exposed on nearly every road near the out-crop of the *Pittsburg*. Openings have been made in it at many places, but they have all been deserted. The character of the bed was fully ascertained by the Messrs. Duncan, who, when they reached it in their shaft, thought they had found the *Pittsburg*, much reduced, and followed it for some distance. Here, as at every other locality where it has been tested within this district, it is a more or less bony coal, leaving a bulky ash. The bed is much troubled by extensive clay-veins.

The interval to the *Pittsburg coal bed* is occupied by sandstone or sandy shale, the Redstone Limestone being absent, or at most represented only by a few nodules of ferruginous limestone.

Along the west face of Chestnut hill, the rocks of the Lower Barren Series are badly shown. The streams flow along the strike in valleys excavated in these strata, and the soft rocks have weathered into nearly sloping hills, which show nothing. Along Jacobs creek some coal blossoms were seen, but they belong to beds so thin as to be worthless.

The Lower Productive Coal Series lies along the face of the mountain, and near the southern part of the township, reaches far up towards the crest of the axis. The only coal exposed north from Jacobs creek is the *Upper Freeport*, and of this the blossom alone is seen, as the proximity of the upper coals, and the numerous openings in the *Pittsburg*, render unnecessary the keeping up of openings in this. The *Upper Freeport* is mined near Laurelville, and is 4 feet thick, with an alternation of coal and shale for its roof. On the pike, the Pottsville (Seral) Conglomerate comes up just east from Laurelville, and continues in sight to within a short distance of the point where the county

line road turns off. It is about 50 feet thick, and barely fails to cross the axis. The other out-crop is reached near Mrs. Mays' house, and the space between the out-crops shows many huge blocks of the Conglomerate. Midway between these out-crops, and almost at the crest of the fold, a coal bed, said to be 2 feet 6 inches thick, was once mined alongside of the pike. This is the bed associated with the Big Bottom Ore, and its place is from 60 to 70 feet below the Conglomerate.

On Jacobs creek the *Mt. Savage*-(?) coal bed is reached at a short distance above Laurelville, on Mr. Shaffer's property, where it was once opened and found to be nearly 6 feet thick. On a run entering here, it is mined by Mr. Patterson, at whose pit it is 3 feet thick, and shows no regular partings. On the same run the following exposure of Umbral Rocks was found, beginning at nearly 50 feet below the Conglomerate:

1. Shale,	25'
2. Coal,	1' 6"
3. Clay and shale,	12'
4. Big Bottom Iron ore—	
Ore,	4"
Clay,	2"
Ore,	8"
	} 1' 2"

No. 1 is a dull brownish-red shale and contains numerous plates of excellent ore, from one half to two inches thick, but they are so widely separated as to be of no value. The coal bed, which has been digged to some extent, is single. shows no partings and seems to be good. Quite an extensive drift was run in on No. 4, and some of the ore was shipped to Charlotte furnace, where it is said to have turned out well. At 6 feet below the base of the section, there is said to be another bed of ore, 18 inches thick, but it is not exposed anywhere in the vicinity as it should be if persistent. At a few feet below the Conglomerate there is a thin coal bed associated with some iron ore, and at twenty feet lower is another ore bed on which a drift was once run. The whole is now effectually closed, and the statements respecting the thickness of the bed are conflicting. According to the best information attainable there is an irregular

collection of nodules through two feet of shale below which is a continuous layer, 6 inches thick. This seems to occupy the place of the Big Honeycomb Ore, and the upper one, that of the Little Honeycomb. No coal was found with the former.

Along Jacobs creek above the mouth of this run, the Conglomerate is constantly exposed, high up in the hills. The springs, issuing from the Mauch Chunk shale of the Umbral, are so heavily charged with oxide of iron that they have deposited an enormous quantity of *bog ore*, which extends for a long way on each side of the stream. The Jude Ore of Fayette county, which overlies the Conglomerate, occurs here, and a trial pit made near the limestone quarry shows it to be about 6 inches thick.

Below the Conglomerate to the Big Bottom Ore the rocks are for the most part dull red shales, but below that deposit to the Umbral Limestone there are alternating bands of sandstone and shale, each about 15 feet thick. The whole interval from the Conglomerate to the Limestone is not far from 175 feet.

The Umbral Limestone is first seen at somewhat less than mile below the old Mt. Pleasant furnace, and at a short distance further up the creek it is quarried. At the quarry it shows:

- | | |
|--|-----|
| 1. Limestone, in thick layers, | 18' |
| 2. Argillaceous limestone, | 20' |
| 3. Compact limestone, | 2' |

No. 1 is very pure, and yields a lime which for whiteness compares favorably with any lime in the market, and is but little if at all inferior to that from Louisville. This portion contains some fossils, but individuals are not numerous. No. 2 is in thin layers, one to two inches thick, some of which are compact and slightly siliceous, while by far the greater portion is argillaceous. The hard layers are made up of crushed and broken shells, but in the other layers the specimens are fine and in prodigious quantity. The number of species is not large and only eight were observed during the examination. No. 3 is not fully exposed. It is seen in the creek at the quarry and is the lowest rock ex-

posed in the gap, for here the axis of Chestnut hill crosses, and at a little way back from the creek the Pottsville Conglomerate is seen arching over the crest. The limestone is said to be only 40 feet thick in a boring made for oil at a little way below this on the creek ; but in the estimate the siliceous limestone cannot be included, for at the quarry the upper division has that thickness.

As one ascends, he sees the upper rocks coming down, the *bog ore* soon appears again in the road and, at the ford-
ing below the old furnace, the Big Bottom Ore is in the creek. Just below the saw-mill, the coal bed above that ore is in the stream, and at the falls above the mill the following section is exposed :

1. Pottsville (Seral) conglomerate,	—	
2. Coal bed,	8"	
3. Clay,	4'	
4. Ore and clay—		
Ore,	2"	} 11"
Clay,	6"	
Ore,	2" to 4"	
5. Clays,	15'	

The coal bed associated with the Big Bottom Ore cannot be more than four or five feet below the base of the section. The clay, No. 3, contains some iron ore in nodules. No. 4 is unquestionably a very fine ore. It bears much the same relation to the coal below, that the plates of ore seen at Shaffer's drift do to the coal there, and it is by no means improbable that here the ore-plates of that section are collected into the two layers of this section. At all events the upper ore beds of the Shaffer section have disappeared, and with them the shales, so as to bring the conglomerate within 35 or 40 feet of the Big Bottom Ore. The little coal of the section is probably the same with that underlying the Conglomerate on Shaffer's property. The ore here has the peculiar structure characterizing the Kidney ore at Lemont furnace, in North Union township, of Fayette county.

On a run entering the creek rather more than half a mile further up, Mr. T. B. Mays has made an exploratory opening in the Big Bottom Ore. The exposure is :

Clay shale, 3 feet ; clay, 4 feet ; ore, 3 feet.

Lumps of ore are scattered through the shale and clay. The ore layer is not a compact mass, but consists of lumps closely packed. But the out-crop has not been passed, and doubtless, as is usually the case with this bed, the lumps will become a compact layer at no great distance under the hill. The great thickness of the ore at this opening renders probable that one of the troublesome horsebacks, so common in this bed, is close at hand. Analysis shows the ore here to be vastly inferior to that obtained in Fayette county. Near Mr. Mays' house the ore has been found in a meadow, where it is said to be much thicker than at this opening. No direct trial has ever been made, and the asserted thickness, 6 feet, is without doubt, a very material exaggeration. At one time the coal above the Big Bottom Ore was mined here. Near the mouth of the pit it is 3 feet thick, and shows no parting. Over it is a mass of shale containing variable plates of ore, and higher up the hill lumps of ore associated with coal dirt have been thrown out by the plow.

Nearly a mile further up Jacobs creek, the *Upper Freeport coal bed* is mined by Mr. J. Freeman, at whose opening the following measurement was made :

1. Shale,	4'	
2. Slaty coal,	1' 1"	} 6' 5"
3. Black clay and slaty coal,	7"	
4. Coal,	3"	
5. Black slate,	6"	
6. Coal,	3"	
7. Black slate,	5"	
8. Ferruginous clay,	4"	
9. Coal,	8'	

At some distance within the pit, No. 3 becomes 14 inches, and is a jet black brittle slate without bedding, and having a fracture like cannel. It does not burn but breaks into small pieces when thrown on the fire. No. 9 alone is mined, so that the bed is known as the "3-foot coal." This lower division is in three nearly equal benches, separated by very thin but persistent partings. Pyrites occurs as nodules in the bottom bench and in the clay immediately below the coal. The parting above this bench is frequently pyritous. The coal burns freely and in the grate shows little tendency to cake. It is used extensively throughout this section.

At 15 feet below this coal bed, as nearly as could be determined from the exposure, the Freeport Limestone is seen in the creek. A lean ore is associated with it. At 35 feet above the *Freeport coal* is another coal bed, 3 feet thick. It has not been opened.

On the Clay pike, north from Mr. J. Freeman's house, the 3-foot coal bed is seen, and at 15 feet higher is another, which is said to be 4 feet. With each of these there is an ore bed. The upper one is of little value, but the lower one is a calcareous ore of by no means poor quality. As exposed at the road-side, it seems to be 2 feet thick. This bed, which is the Johnstown ore, was formerly mined by striping at several places in this neighborhood, and was reduced at the old Mt. Pleasant furnace. The Mahoning Sandstone is not present here, and its place is occupied by a sandy shale. Near this pike, Mr. J. Stairs mines the *Upper Freeport coal bed*. The lower division is the same as at Mr. Freeman's opening, but the upper division shows 2 feet of coal in one layer, and there is evidence of another at 10 inches above.

20. EAST HUNTINGDON TOWNSHIP, OF WESTMORELAND COUNTY.

This lies directly west from Mt. Pleasant, and east from South Huntingdon. The Blairsville synclinal crosses it, cutting the South-West Pennsylvania railroad almost midway between Tarrs station and Stonersville. The section extends from the horizon of the *Waynesburg coal bed* to the Freeport Group in the Lower Productive Coal Series.

The western out-crop of the *Pittsburg coal bed* enters the township near the north-east corner, and follows a west south-west course to Mr. C. Ruff's bank, where it turns south, and crosses the West Newton pike, east from Tarrs station. Thence its line is zigzag, passing through Bethany, and running southward to near the Scottdale and Wagner-ville road, where it turns almost east to the South-West Pennsylvania railroad. Thence its course is north, for a short distance, to Mr. Warden's works, where it turns on itself and goes south. It lies near the railroad to Hawkeye,

where it is turned toward the east, and thence follows that direction until it passes into Mt. Pleasant township.

At Mr. C. Ruff's bank, which is nearly a mile and a quarter north from Bethany, the bed shows:

Roof division,	4'	}	12' 8"
Main clay,	10"		
Lower division,	7' 10"		

The roof consists almost wholly of inferior coal. In the lower division, the benches are 36, 26, 5, 10, and 15 inches thick, there being between the first and second one inch of bony coal. The bed has many thin slaty binders, which render handsome lump coal impossible. The bottom two benches are soft, and in mining break down badly into slack. But one clay vein has been found in this pit. It is 3 inches wide, passes through the entire bed, but does not injure the coal. The under clay occasionally swells, so as to cut out 2 feet of coal for several yards along the entry.

On the road leading east-south-east from this opening, the *Redstone* and *Sewickley coal beds* are exposed by their blossoms. The former is 4 feet, and the latter from 18 inches to 2 feet thick. Neither of them is mined.

Between this and the pike, the *Pittsburg* is mined by Mr. Foutz and Mr. Myers. On the west side of the road are many huge fragments of the Connellsville Sandstone, but the rock was not found in place. On the pike the coal is mined by Mr. J. Tarr, at whose opening the roof division is concealed, and the lower division is 9 feet 4 inches thick, in four benches, 30, 37, 3, and 42 inches. The thickness below the bearing-in is given on the authority of one of the diggers, as the exposure is imperfect. No clay veins have been found here, but the under clay sometimes swells so as to cut out 3 feet of coal. These swells are quite annoying, and in several instances extend for ten or twelve yards along the entry.

South from Tarrs station, the bed is extensively mined by Stoner, Hitchman & Co., who have large coke-works. It has been opened near the mill in Bethany, and on the hill south from that village, the blossoms of the *Redstone* and *Sewickley coals* are shown, while fragments of the Great Limestone are scattered in the fields at a little way off the

road. The blossom of the *Redstone coal bed* is 65 feet above the opening in the *Pittsburg* at the mill. Immediately under it is a reddish limestone, below which to the *Pittsburg* only sandy shale was seen. At the Lutheran church, two miles south from Bethany, there are two openings in the *Pittsburg*, showing:

1. Shale,	20'
2. Roof division,	2' 10"
3. Main clay,	10"
4. Lower division, seen,	8' 4"

The roof division shows two layers of coal, respectively 10 and 12 inches, and separated by 12 inches of clay. South from this the banks belonging to Mr. Stoner and Mr. Leighty were examined, but they show nothing in addition to the section at the church.

Along the South-west Pennsylvania railroad the coal is mined for coking at the Enterprise coke-works, near Hawkeye station, and by Messrs. Hurst, Stoner & Co., and Messrs. S. Warden & Co., near Stonersville. At all of these the section is practically the same. There are extensive coke-works near Overton, and in the road between Overton and the railroad the *Redstone coal bed* is exposed.

Along the railroad, the exposures reach to but a short distance above the *Pittsburg coal bed*. In a cut one mile north from Stonersville, the following section was seen:

1. Sandy shale,	20'
2. <i>Redstone coal bed</i> ,	2' to 3' 6"
3. Dark clay shale,	2'
4. Clay,	5' to 10'
5. Limestone and clay,	2' to 7'
6. Sandy shale,	25'

The *Redstone* consists of fair, though somewhat bony coal, but, as usual, is broken by serious clay veins, one of which, in this cut, is four feet wide and displaces all the coal. The Redstone Limestone, No. 5, is very ferruginous, and some portions are merely calcareous iron ore. The *Sewickley coal bed* is shown at 40 feet higher, and there is some evidence that the Fishpot Limestone is present. The Great Limestone was seen in fragments, but could not be found exposed in place. The whole series is exposed on

the Ridge road, in the eastern portion of the township. There a deserted opening in the *Waynesburg coal bed* was seen, in which the coal appeared to be not far from 5 feet thick.

On the railroad from Tarr's station to Bethany station the rocks of the Lower Barren Series are occasionally shown, and near the latter a short section was found as follows:

1. Sandy shale,	35'
2. <i>Barton coal bed</i> ,	3" to 5"
3. Shale,	10'
4. Limestone,	1'
5. Clay,	3'

And at a few yards beyond there is an imperfect exposure of the Green or Crinoidal Limestone, so that the thin coal of the section is the *Barton coal*. The Mahoning Sandstone is reached at a mile north from Bethany station along the railroad, and at one fourth of a mile further the *Upper Freeport coal bed* is exposed, as follows:

1. Coal,	4"	} 2' 3"
2. Clay,	1"	
3. Coal,	10"	
4. Clay,	2"	
5. Coal,	10"	

Though the bed is so thin there seems to have been much coal taken from it in former times, for there are many deserted openings. In this vicinity the coal is no longer mined.

21. UNITY TOWNSHIP, OF WESTMORELAND COUNTY.

This large township lies between Mt. Pleasant and Derry townships and has Chestnut ridge for its eastern boundary. On the north-east, Loyalhanna creek separates it from Derry. The Blairsville synclinal enters the township just above Latrobe and, following a direct line, passes near the cross-roads, in the village of Pleasant Unity. The Blairsville anticlinal enters near Braeley's old saw-mill, on the Loyalhanna, and crosses the Pennsylvania Central railroad at somewhat more than half a mile west from Kearney station, or better, between the telegraph station and Carr's

tunnel. It was found on the Greensburg pike, at barely half a mile east from Nessler's store, but all attempts to trace it further south were unsuccessful, and the fold evidently disappears within three miles south from the pike. This township embraces portions of the Blairsville and Greensburg troughs. The section, as exposed, reaches from the Waynesburg Sandstone to the Catskill Rocks.

The eastern out-crop of the *Pittsburg coal bed* enters the township at the south near the village of Lycippus, and thence northward to the Greensburg pike, it is marked by a line of low hills, which lie from one-fourth to one-half mile west from Nine-Mile run. It crosses the pike at one-third of a mile west from Youngstown, and there is deflected north-westward by the influence of Loyalhanna creek, so as to cross that stream at not far from a mile above Latrobe. The western out-crop enters at the north near the railroad bridge over the Loyalhanna and, after lying close by the railroad for nearly half a mile, turns abruptly westward, and retains that course to the Presbyterian church. Just north from that church it is deflected southward to the railroad, which it crosses at Beatty station. It reaches the Greensburg pike at the blacksmith's shop, and thence follows a rudely south-south-west course for two miles and a half, after which it is folded on itself by streams forming one fork of Sewickley creek, and describes some eccentric curves, the line being doubly indented. Resuming its previous course, it passes into Mt. Pleasant at about one mile from the border of Hempfield township.

Near the village of Lycippus, the *Pittsburg coal bed* is mined by Mr. Trauger, and further north by Mr. Keubler and Mr. J. Dougherty, at whose openings it shows a section very much like that seen at Mr. Rambaugh's bank, in Mt. Pleasant township. No other mines were examined until Mr. J. D. Anderson's was reached on the Greensburg pike, near Youngstown. There the roof is very irregular, containing few and thin streaks of coal. The lower division is not fully exposed, and only 7 feet of the coal were seen. The dip is 5 degrees west-north-west. North from the pike, openings were seen belonging to Mr. Karns, and on the

Baldrige property, but at both of these the roof is not exposed.

Along the railroad, the Pittsburg Sandstone remains in sight above the track for more than a mile west from Latrobe. The *Pittsburg coal bed* is mined in the bank of Loyalhanna creek, near the railroad bridge, and at half a mile from Latrobe are the mines of Lloyd, Huff & Co. directly alongside of the track. The coal is reached by means of an incline, and is said to be only 20 feet below the surface. No measurements could be made, as the works have been stopped and the incline is filled with water. At a mile from Latrobe, Morgans & Co's. works were seen. Here the coal is reached by an incline, beginning in the Pittsburg Sandstone, and is said to be 120 feet below the surface. This seems hardly possible, but the incline follows the dip of the rocks, which is very sharp. The works have been idle for more than a year, and the incline contains water up to within 25 feet of the surface, so that no measurements could well be made.

In a cut, west from these works, the dip is locally reversed, and the shale overlying the sandstone is exposed; but in the next cut, the dip is restored. The reversal must be sharp, for in the second cut the shales are seen, which overlie the *Redstone coal bed*, near St. Clair, in Derry township. From this point to Beatty station, owing to the direction of the road, the rocks rise slowly, and the *Pittsburg coal* is not seen until that station is reached. In the cut there the following section is exposed:

1. Shale,	10'
2. Pittsburg sandstone,	20'
3. Dark shale,	6' to 10'
4. <i>Pittsburg coal bed</i> —	
Roof division,	4" to 6"
Main clay,	3" to 6"
Lower division,	7' 11"
	8' 11" to 11' 3"
5. Clay,	3'
6. Ferruginous limestone,	1'
7. Sandy clay,	2'
8. Iron ore,	5"
9. Blue shale,	8'

The bottom of the sandstone describes a series of curves,

some of which cut out part of the shale below, while others do not affect it. The shale, No 3, and the roof division of the *Pittsburg coal* participate in these curves, the latter varying its position at the expense of the main clay parting, but the lower division of the coal bed is wholly unaffected by these distortions. In the bottom 2 feet of the sandstone, there are frequently thin pots of coal 2 to 4 inches thick, which taper away at each end, and directly under the sandstone when the curves are very sharp, coal is found, but elsewhere it is absent. One of these curves, about 4 feet from base to base, catches 10 inches of coal on both sides of the cut. No doubt these fragments are the remains of a coal bed torn away during the deposition of the sandstone. No coal occurs in the shale No. 3, but the main clay parting, when thick, shows variable strings of coal which distinctly come from the roof division. The lower division shows three benches, 48, 3, and 42 inches thick, with a 1 inch clay parting above and below the bearing-in. In the bottom bench there are many binders, but none of them is sufficiently persistent to be a parting.

The iron ore of the section is inferior, and for all practical purposes is worthless. The blue shale is quite micaceous.

Between the railroad and the Greensburg pike, the openings in the *Pittsburg coal* are numerous, and resemble each other closely, though they show marked differences from the section in the cut at the station. The bank belonging to Mr. Kehoe is an old one, extensively worked, and shows the following structure:

1. Sandstone,	—	
2. Shale,		6"
3. <i>Pittsburg Coal bed</i> —		
Roof division,	1'	} 10' 10"
Main clay,	1' 6"	
Lower division,	8' 4"	

The lower division shows four benches, 8, 52, 3, and 38 inches thick. The top one is bony, as is so frequently the case in this trough. No distinct parting was found in the bottom bench. The roof is excessively bad, and the utmost care is required to prevent dangerous falls. The clay of

the main parting occasionally swells, and cuts away much of the breast coal.

At Mr. W. F. Gallagher's opening, two miles and a half south from the Greensburg pike, the roof division shows a marked change. On the railroad, that division consists of 3 inches of coal, at Kehoe's of 1 foot of coal, but here the section of the bed is :

1. Sandy shale,	4'
2. Roof division—	
Coal,	4"
Clay,	2"
Coal,	2"
Clay,	2"
Black shale,	12"
Coal,	2"
Sandy shale,	6"
Coal,	5"
Black shale,	0" to 12"
Coal,	1" to 5"
3. Main clay parting,	1' 6" to 1"
4. Lower division,	7' 9"

In this as well as in an adjoining opening belonging to Mr. Kingsworth, there seems to be some coal above the shale No. 1. Here, then, in a total of 4 feet 4 inches in the roof, there are seven layers of coal and richly carbonaceous shale, aggregating about 3 feet. The lower division shows 5 benches, 8, 28, 30, 10, and 15 inches thick, the ordinary bearing-in bench being confounded with the brick, which has a one-inch parting above and below it. The first three benches are really sub-divisions of the breast coal, and the partings between them are not wholly persistent. The top bench is so bony that it is not removed. In the same vicinity is Mr. Harold's bank, which is quite similar to the one just given. At about half a mile further south-west, the same coal is mined by Mr. George Chambers, at whose opening the structure is wholly different from the last given, the exposure being :

Roof division, 4 feet 3 inches ; main clay, 3 feet to 6 inches ; lower division, 8 feet 4 inches.

The roof shows two layers of coal, 15 and 24 inches, separated by an imperfectly exposed interval of one foot, which seems to contain a good deal of coal. The whole is very

slaty, and is regarded as worthless. In the lower division, the benches are 8, 13, 36, 3, 10, and 18 inches, showing the brick and lower bottom distinct from each other, and from the bearing-in. At all the openings in this vicinity the coal is handsomely irised. It is brittle, and needs careful handling, but is a decidedly good article. Clay veins are of rare occurrence, and in Mr. Chambers' mine, which is the most extensive, only one has been found. That is but 2 inches wide, and does little injury to the coal. The roof clay sometimes cuts out the top bench of 8 inches, and the under clay occasionally swells so as to displace the lower bottom; but these are not regarded as serious troubles, for the benches affected are not mined. Almost due west from Mr. Chambers is another opening, and south from that is a second, near Hamm's mill. Beyond these, to the township line, no pits were seen in operation.

Within the area included between these out-crops, the surface at some points rises to a considerable height, and not unfrequently the rocks immediately above the *Waynesburg coal bed* are exposed; but the exposures are fragmentary and so far separated that trustworthy sections could be compiled only with the utmost difficulty. Along a ridge road leaving the Greensburg pike at the western out-crop of the *Pittsburg coal bed*, the *Waynesburg coal bed* was seen at two miles from the pike, associated as follows:

- | | |
|------------------------------------|------------|
| 1. Waynesburg Sandstone, | 40' |
| 2. Waynesburg coal bed, | Blossom. |
| 3. Sandy shale, | 25' |
| 4. Waynesburg Limestone, | Fragments. |

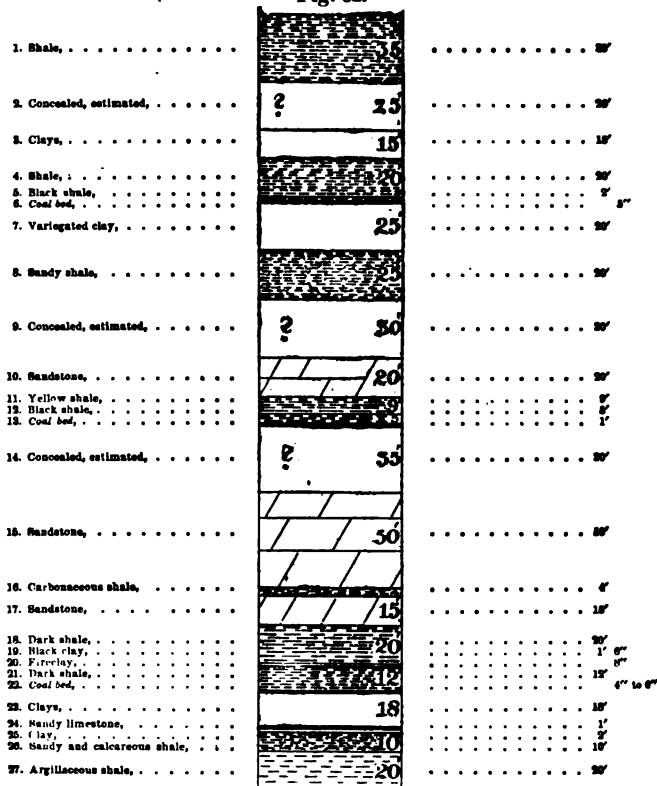
The coal remains in sight along the road to within half a mile of the school-house, and at one point a prospector has exposed the entire bed of coal at the roadside, showing its structure to be as follows:

- | | | |
|--------------------------|----|---------|
| 1. Black Clay, | 5" | } 4' 5" |
| 2. Coal, | 1' | |
| 3. Clay, | 8" | |
| 4. Coal, | 1' | |
| 5. Clay, | 4" | |
| 6. Coal, | 1' | |

The coal appears to be slaty throughout and is evidently
18—KK.

worthless. The *Sewickley coal bed* is concealed here, and the *Redstone coal* is exposed near Mr. Nichol's house as a carbonaceous shale. The interval between the *Waynesburg* and the *Pittsburg*, measured on a line but little off the strike is found to be 260 feet, so that the true interval cannot be far from 280 feet. In the vicinity of Pleasant Unity, the hills are high enough to catch the *Waynesburg* limestone, which is exposed in the village; and near Mr. W. Graff's house, the lower division of the Great Limestone is well shown in the road at 25 feet above the *Sewickley coal bed*. The coal seems to be about 4 feet thick, but it has never been opened. On the hill east from Mr. Graff's house the *Redstone coal bed* is represented by a thick bed of black shale.

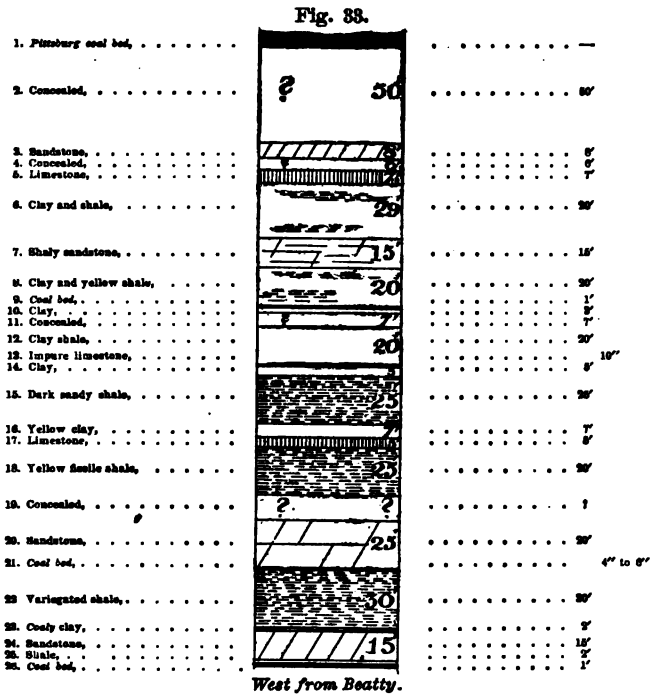
Fig. 32.



East from Georges.

In the extreme northern part of the township there are some small patches of the *Pittsburg coal bed* belonging to the Greensburg trough. They are of only local value and the openings show a structure similar to that exhibited by those seen within the same area in Derry township on the other side of the Loyalhanna.

The Blairsville anticlinal crosses the Pennsylvania railroad near Carrs tunnel, and the rocks of the Lower Barren Series are fairly well exposed on each side. Of the sections, Fig. 32 was obtained on the west side, beginning at Georges station and going east to the axis, while Fig. 33 was obtained in going west from Beatty station.



No. 1 of the first section begins at 103 feet below the *Pittsburg coal bed*, and the other part of the section will be found in the description of Hempfield township. The concealed intervals in the first section are estimated from the distances between cuts, for the roads within half a mile of the railroad on either side afford little assistance in filling the gaps, and

it would be unsafe to go further than that, since the rocks of this group are so variable that the section cannot be carried. No. 2 of the first section is the broad valley just east from Georges station. Toward the base of this interval, there is a coarse limestone, 2 or 3 feet thick, overlaid by 15 feet of variegated shale. These are exposed on the road leading to McGuire's crossing. On the same road the coal bed, No. 6, is shown, and is one foot thick. From the exposures on this road, it seems probable that the interval No. 9 contains a thin coal bed. The coal bed, No. 13, is seen in the first cut west from Carr's tunnel, where it has been stripped for use in burning lime. The black shale overlying it is very rich in carbon, and the whole mass makes a broad blossom. Between the coal bed and the sandstone, No. 15, there seems to be nothing but shale, which is partially exposed on the road running parallel with the track. The rest of the section was obtained at Carr's tunnel.

The sandstone, No. 15, is irregularly bedded, evidently compact at the base, but becoming flaggy toward the top. It forms both walls at the west end of the tunnel. The carbonaceous shale underlying this could not be reached, so as to secure a close examination, as it is on top of the tunnel. It probably contains some coal. No. 17 is a very coarse sandstone, and in some parts is a true conglomerate. It holds much carbonized vegetable matter and some imprints of stems. In many respects, this whole mass, 15, 16, and 17, bears a marked resemblance to the Mahoning Sandstone, but the section above and below it seems to show conclusively that it is not that stratum. The black clay, No. 19, is very ferruginous and full of small fossils, but everything is so disintegrated for many inches from the out-crop, that not one of the species could be determined. The dark shale below it is sandy, micaceous, and, in some of the more clayey layers, contains occasional specimens of *Lima retifera* and *Ariculopecten recti-lateraria*.

The clays, No. 23, have a layer of lean iron ore at 2 feet below the coal and another at about the same distance above the limestone, No. 24. Scattered throughout the mass are nodules of limestone, which, in one portion of the cut, are

collected into a single layer 10 inches thick. The sandy limestone is fossiliferous, and in many respects resembles the Black Fossiliferous Limestone seen in North Huntingdon township. Like that it contains many streaks of carbonaceous matter, which give it a dark tint on the freshly fractured surface. The upper portion of No. 26 is quite calcareous, but passes gradually into the sandy shale below.

The second section was obtained on the railroad between Beatty station and the telegraph station east from the tunnel. Its lower portion is the same with that of section 1. The little coal, No 22, and its overlying sandstone are clearly equivalent to Nos. 15 and 16 of the other section. They were seen at Kearney station. The exposures for a mile east from Kearney are very unsatisfactory, and there is a great interval which cannot be filled. No rocks are shown in the streams or on the roads near the railroad, and the hills are covered with a thick coat of debris.

On the Greensburg pike the great sandstone of the tunnel section is exposed at a little way east from Nessler's store, and beyond it eastward is a mass of black shale and coal which has been prospected. The latter is no doubt the equivalent of Nos. 12 and 13 of the first section.

Along the Loyalhanna no section is exposed. Near Braeley's old mill, where the Blairsville anticlinal crosses the creek, there is a thin coal bed, which is probably the *Upper Freeport*. It varies from 3 to 4 feet, and yields coal of rather inferior quality.

The face of Chestnut hill, in this township, is an unbroken wilderness, still covered by the forest. A few rugged roads lead partly up its side and one crosses the crest. On all of these, the coating of debris is so thick as to conceal every trace of coals or other rocks in place. The nearness of the *Pittsburg coal bed* and the numerous openings in it, have rendered unnecessary the expense of keeping up banks on the poorer and thinner *Upper Freeport*, so that no information respecting that bed can be obtained except near the Loyalhanna. In the vicinity of that stream, not far from Youngstown, the *Upper Freeport coal bed* was opened by J. Shirey and Col. Johnson, but of these, all but the last

opening is in a state of total collapse. At Col. Johnson's the bed shows :

Coal,	2' 10"	}	4'
Clay,	1"		
Coal,	1' 6"		

The coal is sulphurous and much broken by thin slates. Not even the blossom of any of the lower coal beds was seen at any locality. The rocks underlying the Lower Productive Coal series are poorly exposed on the south side of the Loyalhanna, but are well shown on the north side, which is in Derry township.

22. DERRY TOWNSHIP, OF WESTMORELAND COUNTY.

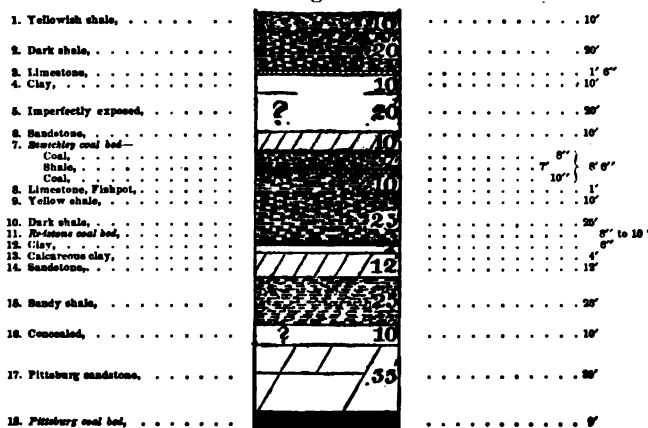
This is the north-east township along the west side of Chestnut hill. It has a long front on the Conemaugh river, and is separated from Unity and Salem townships by the Loyalhanna. The Blairsville synclinal enters it at the bend in the Conemaugh, almost due south from Blairsville, and crosses the Pennsylvania railroad at a few yards west from Loyalhanna station, passing about a mile and an eighth west from the cross-roads, in New Derry. The Blairsville anticlinal enters on the Conemaugh nearly half a mile west from the lock-house, below Blairsville, crosses the Conemaugh pike somewhat less than half a mile east from Spruce run, and passes out of the township into Unity near Braeley's old mill on the Loyalhanna, three miles in a straight line below Latrobe. The eastern boundary of the township is the crest of Chestnut hill. The exposed section reaches from the *Waynesburg coal bed* to the Catskill rocks.

In the eastern portion of the township, the *Pittsburg coal bed* underlies an area in the Blairsville trough, varying from one mile and one-fourth to nearly three miles in width. In the extreme western portion is an outlying area of the same bed, belonging to the Greensburg trough.

The out-crop line of the *Pittsburg coal bed* on the east side of the Blairsville trough enters this township on the Loyalhanna, about a mile from Latrobe, and runs almost east for somewhat more than a mile, when it turns abruptly north-east and continues in that direction for nearly the

same distance. By the valley of Saxman's run it is bent westward, but returning, it crosses the railroad at St. Clair. Thence northward for nearly two miles and a half, it lies but little west from the road to New Derry, but crosses that road at three-fourths of a mile south from Derry, and passes at about the same distance east from that village. Thence, to within two miles of the Cone-maugh river, the line follows an east of north course, and lies for the most part at from one-fourth to one-third of a mile west from McGee's run. But at two miles from the river the coal is in the run, and thence to the river is in the bluffs alongside of the stream. Along the river it is exposed in the bluffs until within a very short distance of Bairdstown, where the line curves back into the hills and the western out-crop is reached ; the line of out-crop now follows a very regular south-south-east direction for four miles, excepting one indentation on Stoney run, first crossing that run about two miles from its mouth, and again at Dunlap's old saw-mill. A second indentation is made by the east fork of Stoney run, beyond which the line makes a very considerable sweep westward along the other fork. Under the influence of Lomison's run it returns south-east and crosses the New Derry and New Alexandria road two miles west from the former village and returns to the same

Fig. 34.



Pennsylvania Railroad.

road nearly half a mile further east. Thence it lies on the east side of the run to the Loyalhanna and follows the course of that stream to the railroad bridge, where it crosses the creek into Unity township.

Along the Pennsylvania railroad the section given in Fig. 34 is exposed between Latrobe and St. Clair.

The top of the section is seen in the cut at Loyalhanna station. The limestone, No. 3, as shown there is hard, breaks with a conchoidal fracture and contains no fossils. It is the remnant of the Great Limestone, which, in Fayette county, has a thickness in this trough of more than 50 feet. The clay below it is not bedded. The sandstone, No. 6, is seen in the second cut west from St. Clair, as well as in the low cut under the tippie of the Loyalhanna Coal and Coke Company ; but at the latter locality it is reduced to a mere sandy shale. In the second cut west from St. Clair the *Sewickley coal bed* is concealed, but the interval in which it should occur shows smuts of coal. In the other cut, just referred to, both of the coals belonging to this bed are exposed. The upper one has two layers, each 3 inches, separated by four inches of bony coal or carbonaceous shale. The lower bed is imperfectly shown, but is evidently as thick as is given in the section. The limestone, No. 8, is not present in the Loyalhanna company's cut, but in the one near St. Clair, it is an irregular layer of calcareous nodules. It is absent at all localities north from the railroad, so that this is the last exposure of the Fishpot Limestone in this basin.

The shales, Nos. 11 and 12, appear on both sides of the trough, and are well exposed in the second cut west from St. Clair. The lower, or dark shale, contains a layer near the top, which is very carbonaceous, breaks much like an inferior cannel and is one foot thick. This shale shows many indistinct vegetable impressions throughout. On the railroad the *Redstone coal bed* was seen only near St. Clair, but it seems to be thoroughly persistent southward, and, though thin is of very good quality. The calcareous clay underlying this coal represents the Redstone Limestone, which disappears even as calcareous clay immedi-

ately north from the railroad, though at a short distance southward it is a ferruginous limestone. The Pittsburgh Sandstone is exposed in the first cut west from St. Clair station, and again at three fourths of a mile east from Latrobe, from which point to that borough it is constantly in sight. It is flaggy, much cross-bedded, quite soft, and is broken by vertical joints. No portion is in sufficiently thick layers to fit it for building purposes. From the exposures near Latrobe, it seems probable that the concealed interval, No. 16, is occupied by this sandstone.

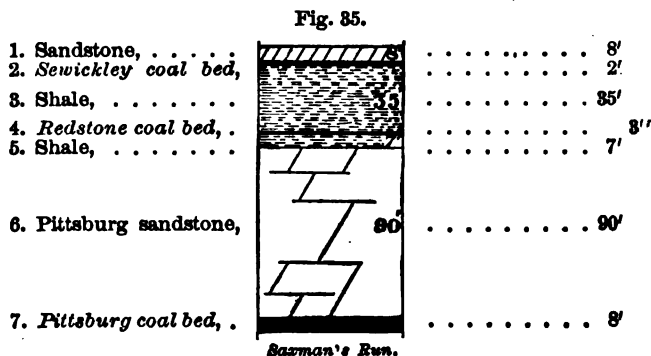
At a short distance west from Loyalhanna station, and at not more than fifty or sixty yards from the exact line of the synclinal axis, the Loyalhanna Coal and Coke Company mine the *Pittsburg coal bed* by means of a shaft which is 128 feet deep to the coal, and begins at 15 feet above the lower one of the coal beds, referred to the *Sewickley*. There is, therefore, an error of 8 feet in the section as measured along the railroad. The dip southward at the bottom of the shaft is 22 feet in 500 yards, or at the rate of 90 feet per mile. In the direction of full dip, or east-south-east, the rate would be nearly two degrees, which is a remarkable dip so near the axis. At these works the lower division of the *Pittsburg bed* varies little from 8 feet. The roof division is very indefinite. Between the main coal and the overlying sandstone there intervenes from 6 inches to 5 feet of shale. When this is thick its lower portion contains irregular strings of coal, which represent the roof division. No clay-veins have been found, and the swells of the under-clay are insignificant. The coal is quite soft and, of the whole mass mined, only one half remains as lump coal after screening. The slack is coked and the company has one hundred ovens. The present capacity of the mine is six hundred tons per diem.

Along the eastern out-crop, the *Pittsburg coal bed* is mined south from the railroad by Mr. Burkholder, Mr. Murphy, Mr. Snyder, Mr. Noel, and others. At Mr. Murphy's bank, on Saxmans run, the exposure is :

1. Pittsburgh sandstone, seen, 10'
2. Clay, 0' to 1' 2''

3. Coal,	1'	} 7' 8"
4. Clay,	1' to 0"	
5. Coal,	1' 11"	
6. Coal and partings,	4"	
7. Coal,	4' 5"	

The Pittsburg Sandstone, as on the railroad, is cross-bedded. In this vicinity it frequently rests on the coal, though it does not form a true horseback. When the sandstone swells, it causes a twisting or distortion of the coal, which in some cases reaches downward 3 feet, as though the pressure had been exerted on a soft mass, which had little opportunity for escape at the sides. The bed shows material variations in thickness, one full measurement in Mr. Murphy's pit giving only 6 feet 6 inches, while one in Mr. Noel's bank, near by, shows 8 feet 6 inches of coal. There are numerous thin clay partings, and the coal has a prismatic structure, so that it is quite brittle. The roof division is wholly wanting in this vicinity. On the hill, descending to Saxman's run, near St. Clair, a partial section was obtained, as represented in Fig. 35:



Here both the limestones are wanting, thus showing that they have become extremely irregular. The Pittsburg sandstone has absorbed the sandy shale seen on the railroad, and that portion is here very compact, so that it is well fitted for building purposes.

Half a mile north from St. Clair, the *Pittsburg coal bed* is mined by Mr. Braden, and at a mile further, by Mr. Mr. Nichols. Neither of these openings affords an expo-

sure of the roof. At the latter, there rests on the coal sandy shale, 50 feet thick, above which is the *Redstone coal bed*, embedded in a mass of black shale. This coal bed is again seen at half a mile south from New Derry, and at 70 feet higher is the limestone, No. 3, of the railroad section. This limestone is exposed again near Derry. Within two miles and a half, the interval between this limestone and the *Pittsburg coal bed* has diminished from 170 to 120 feet. At 30 feet above it, there is a thin coal bed, which no doubt represents the *Uniontown*. The *Sewickley coal bed* was not seen north from the railroad.

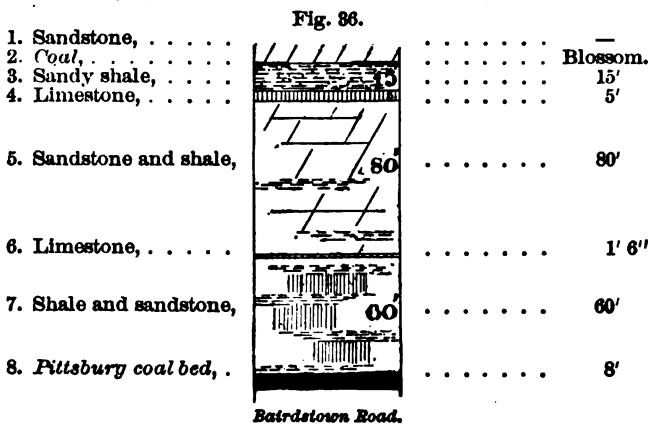
About three-fourths of a mile east from New Derry, the *Pittsburg coal bed* was once mined by Mr. Breniser, but the opening has been deserted for a long time, and it is now effectually closed. Nearly a mile further northward, along the out-crop, the bed is mined by Mr. Walkinshaw, but the exposure is such that the presence of the roof, and the character of the overlying rock cannot be ascertained. The coal resembles that seen at the other openings, having little pyrites visible, and being much broken by thin partings, as well as by vertical cleavage. At a mile and a half further north is Mr. Bennett's opening, where the roof division is clearly present, but nothing respecting it can be ascertained from the exposure. Of the lower division, 7 feet were seen. Near the mill, about a mile and a half south from the broad ford of the Conemaugh, several openings were seen, one of which shows the roof to be 2 feet 6 inches, consisting of coal and shale, each in thin layers. At a short distance further down the run, the coal is extensively mined and coked by the Coketon Coal and Coke Company. On the river bluff, just below the mouth of McGee's run, an exposure shows:

- | | | |
|------------------------------------|-------|---------|
| 1. Pittsburg sandstone, | 40' | |
| 2. Shale, | 6' | |
| 3. Roof division, | 3" | |
| 4. Main clay parting, | 1' 3" | } 7' 7" |
| 5. Lower division, seen, | 6' 1" | |

At another opening, further down the river, the roof division contains 1 foot of bony coal. The overlying shale is quite irregular, and is much cut out by the sand-

stone, which forms a marked feature in the bluffs. There are numerous country pits along the river to within two-thirds of a mile of Bairdstown, where the out-crop line leaves the river hills. The Connellsville Sandstone comes up at a short distance beyond where the axis of the synclinal crosses the river, and rising rapidly, is soon at the hilltop. The upper portion of the Lower Barren Series is very fairly exposed opposite Blairsville.

On the Bairdstown and New Derry road a very instructive section was obtained, about two miles from the Blairsville and Pittsburg pike. It is as shown in Fig. 36:



At one locality a coal blossom is seen about 5 feet above the limestone, No. 6. In all its characters this limestone is similar to that observed on the railroad, at Loyahanna station, and on the road south from New Derry. It is clear, then, that the interval of 170 feet, on the railroad, which became 120 feet near New Derry, is here only 60 feet, while the coal bed, 30 feet above it, near New Derry, is only 5 feet above it here. If this be the *Uniontown coal bed* and the Great Limestone, as there seems to be no reason to doubt, then the upper coal bed must be the *Waynesburg*. Both limestones of the section have been burned for lime.

On Stoney run, along the western out-crop of the *Pittsburg coal bed*, the coal is mined by Rev. J. Davis, Mr. J. Donnelly, the heirs of W. Donnelly, and others. The section at the W. Donnelly bank is as follows:

1. Shale, seen,	3'	} 8' 2''
2. Coal,	3' 8''	
3. Clay,	1''	
4. Coal,	3''	
5. Clay,	1''	
6. Coal,	1' 10''	
7. Clay shale,	1' to 8''	
8. Coal,	1' 6''	

Nos. 4 and 6 are very prismatic, and evidently can bear but little handling. No. 2 is brittle, but has a distinctly laminate structure. For 26 inches, at the top, it is semi-cannel, with layers of ordinary bituminous coal, which prevent it from being wholly free-burning. No. 7 is the parting between the brick and lower bottom, and is a black fissile shale, containing a considerable amount of pyrites. Some nodules of pyrites occur in the top of the upper bench. A peculiarity in this vicinity is the columnar structure of the brick coal. On the east fork of this stream Mr. H. McFadden has an opening, which shows a similar section, the roof division being altogether wanting.

On Lomisons run, which heads near the New Derry and New Alexandria road, about a mile west from the former place, and empties into the Loyalhanna, about half a mile below the mouth of Saxmans run, the coal is mined at numerous openings, all of which are alike. Near the New Derry road, Dr. Lomison has several pits, which show the following structure:

1. Shale,	8'	} 8' 1''
2. Sandstone,	10''	
3. Clay,	3''	
4. Roof coal,	3''	
5. Main clay,	5''	
6. Coal,	4' 1''	
7. Coal and partings,	4''	
8. Brick coal,	10''	
9. Coal and parting,	3''	
10. Clay shale,	10''	
11. Coal,	1' 2''	

No. 10 is not the same clay as that observed in the Donnelly pit, for there it lies directly under the brick bench, while here it is fairly in the lower bottom. The character is the same at both localities. Other openings were observed along this run, but they resemble those just referred

to. The thickened parting becomes insignificant towards the Loyalhanna, and along that stream is wholly wanting. At the mouth of Saxmans run the coal is mined by Messrs. M. Saxman, jr., & Co., at whose mine 12 feet of shale intervenes between the coal and the Pittsburg Sandstone, which is a flaggy, twisted rock, containing great numbers of vegetable stems. The roof division is but 4 inches thick, and is separated from the lower division by 1 foot of clay. The latter is 7 feet 8 inches thick, and the parting below the brick is barely 1 inch. The coal is soft, and the proportion of lump coal is little more than one-half.

On the Blairsville and Pittsburg road, which is usually known as the Conemaugh or Northern pike, everything is concealed between the out-crops of the *Pittsburg coal bed*. On the road from New Derry to New Alexandria, the exposures are almost equally poor. About four miles from the latter place, the *Barton coal bed* is seen 10 inches thick, associated with black shale, and the whole embedded in variegated shale. The Green or Crinoidal Limestone was not seen on the east side of the Blairsville axis on this road, but on the west side a fragmentary exposure was found, about two miles from New Alexandria.

Fragments of the Greensburg area of the Upper Productive Coal Series occur east and north-east from New Alexandria. The out-crop line on the eastern side crosses the Conemaugh pike near the old toll-house, and runs irregularly northward to the line of Loyalhanna township; the area being there broken up into a number of small patches, which are not indicated separately on the map. The direction of this out-crop is determined by a run entering the Conemaugh near the Big Bend. South from the pike the area is very limited, the rocks being cut away by the Loyalhanna and its tributaries. The western out-crop makes an exceedingly tortuous line, which crosses the Saltsburg road twice within a mile from New Alexandria, and afterwards lies east from that road to the junction with the eastern out-crop. There may be a small area between the New Derry road and the Loyalhanna, but if there be, it has but little cover, and is of no commercial value. On the eastern side of the area, the

bed is mined by Mr. J. Patterson, Mrs. Elder, and others. The section at the first of these openings is:

1. Pittsburg sandstone,	—	
2. Shale,		2"
3. Roof Coal,	6"	} 7' 10"
4. Main clay,	1' 6"	
5. Lower division,	5' 10"	

The main clay is sometimes only one inch. In the lower division, the breast or upper bench is 3 feet 2 inches thick, and the "bottoms" below the "bearing-in" are 2 feet 4 inches. There is no distinct parting between the "brick" and the "lower bottom," though occasionally the coal separates at from 10 to 15 inches below the "bearing-in." No clay veins occur in this vicinity, and only one horseback has been found. This is simply a swell in the roof clay, and cuts out one foot of coal for a distance of less than six yards. The other openings along this out-crop show a section similar to that just given, differing only in the upper bench, which is usually about 4 feet 6 inches thick.

On the western out-crop, the openings of Messrs. Parr, Anderson, H. Seanor, and W. Seanor were examined, all of which are within the principal area. Aside from these, there are several pits in an out-lying patch, stretching along the Loyalhanna to within a short distance of Mr. John Snodgrass' mill. At Mr. W. Seanor's bank, the section is:

1. Dark shale,	—	
3. Main clay,	1' 6"	} . . 9' 5"
3. Lower division,	7' 11"	

The structure of the lower division is peculiar, as follows:

Coal, 4 feet 11 inches; *bony coal*, 1 inch; *coal*, 3 inches; *coal*, 10 inches; *brick*, 6 to 8 inches; *lower bottom*, 1 foot 4 inches.

Between all these divisions are well-defined clay partings. A similar structure was observed in a neighboring pit, but it does not seem to be persistent in the vicinity.

Of the Lower Barren Series, a few short and unsatisfactory sections were obtained along the Conemaugh river, but they show nothing worthy of record, as they are from the upper portion, in which the variation is always extreme. Sections were obtained at the same localities during the former geo-

logical survey, and are published in the final report of that survey. Along the foot of Chestnut ridge, the opportunity for obtaining sections is quite as bad as along the Conemaugh and Loyalhanna further down. Immediately upon issuing from its gap in the mountain, the Conemaugh flows through a broad bottom, cut out of the Lower Barrens and the Lower Productive Coal Series, and the Loyalhanna does the same. The streams flowing along the base of the mountain, and just east from the foot-hills, in which the eastern out-crop of the *Pittsburg coal bed* is found, run through broad valleys, eroded from the Lower Barrens, where debris effectually conceals the strata, while the cuts on the Central railroad are few and widely separated. The rapid dip of the strata along the side of the mountain, renders the narrow valleys of the little streams emptying into the Loyalhanna and Conemaugh sufficiently wide to have removed all the lower coals from their eastern side, while the erosion is not deep enough to make extensive exposures on the western side. On the mountain slope itself, the covering of debris from the Conglomerate, as well as from the lower rocks, is so thick, that even the smut of a coal seam is rarely seen in the deepest cuttings along the few roads crossing the ridge. In the gaps made by the Conemaugh and the Loyalhanna, the material was obtained for compiling a complete section of the rocks underlying the Pottsville (Seral) Conglomerate, in so far as they are brought up under this axis.

Just east from Millwood station, on the Central railroad, the *Upper Freeport coal bed* has been opened, but at the time of examination the pit was not in condition to admit of measurement. Further south, on the road leading from New Derry to Ligonier, the same bed is mined by Mrs. Norris, at whose opening it shows :

1. <i>Coaly shale</i> ,	6"	} 8' 1"
2. <i>Coal</i> ,	3'	
3. <i>Shale</i> ,	1' 6"	
4. <i>Coal</i> ,	3' 1"	

The Mahoning Sandstone seems to rest directly on the bed, and is seen in massive fragments covering the hillside. The coal is equally good in both benches though, by some

persons, that from the upper one is preferred. The middle shale is black and frequently shows streaks of coal. No clay veins have been found, and horsebacks occur but rarely. Further up the side of the ridge on this road, the bed has been opened by Mr. Thomas, whose bank, at the time it was visited, was so full of water that it could not be entered. The owner states that the middle shale is only 8 inches thick, and that the upper bench measures 5 feet 6 inches, the total thickness being 8 feet. Such a change is by no means impossible, or even improbable, in this bed, for on Millers run, about three miles from these openings, the section shown in Fig. 37 was obtained at a lime quarry :

Fig. 37.

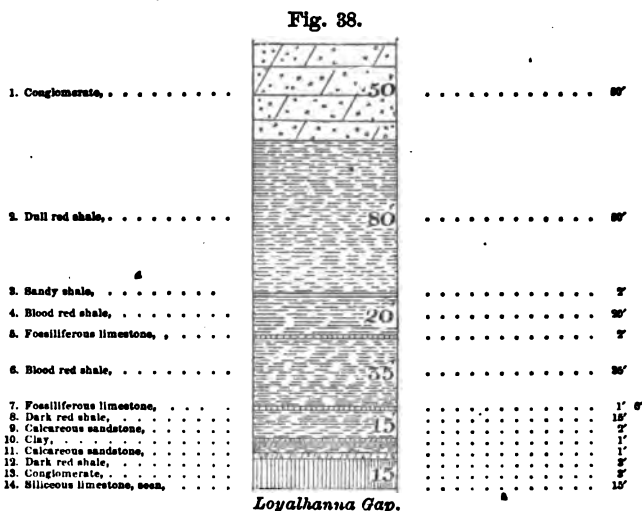


At two other openings in the coal seen further down the run near Loyalhanna creek, the structure is the same, but the upper bench is 2 feet 10 inches and the clay is 1 inch. The coal is sulphurous, and badly broken by numerous thin partings, so that it is liable to be reduced to very fine slack unless mined with the utmost care. It is evidently a fat coal, but the proportion of sulphur is too great to admit of profitable coking or of its use in the manufacture of gas.

Along this run and the Loyalhanna, the Mahoning Sandstone is a flaggy rock, irregularly bedded and of no economical value. Its texture is coarse and uneven. Impressions of plants are common, and occasionally one sees a cast. The clay, No. 5, is of uneven quality and of little value, as it consists of alternating layers of sandy and compact clay; the latter quite as good as that obtained at the same horizon near Bolivar. Toward the bottom its out-crop is badly stained by iron. The other clays of the section are worthless. Of the Freeport Limestone, which is only partially exposed, the upper layer is very argillaceous, has a very uneven fracture, and contains some minute fossils. The lower portions are thought to be good, and are quarried for lime.

No rocks of the Lower Productive Series, lying below the section given, are exposed within this township, but at the mouth of Miller's run the Mahoning Sandstone is seen on the west side of the valley, while on the east side the Seral Conglomerate comes down to the stream with a rapid dip, and forms the east wall of the little valley.

Passing up the Loyalhanna from the mouth of Millers run, along the grade for the Ligonier and Latrobe railroad, a section of the lower rocks was obtained, which is given in Fig. 38:



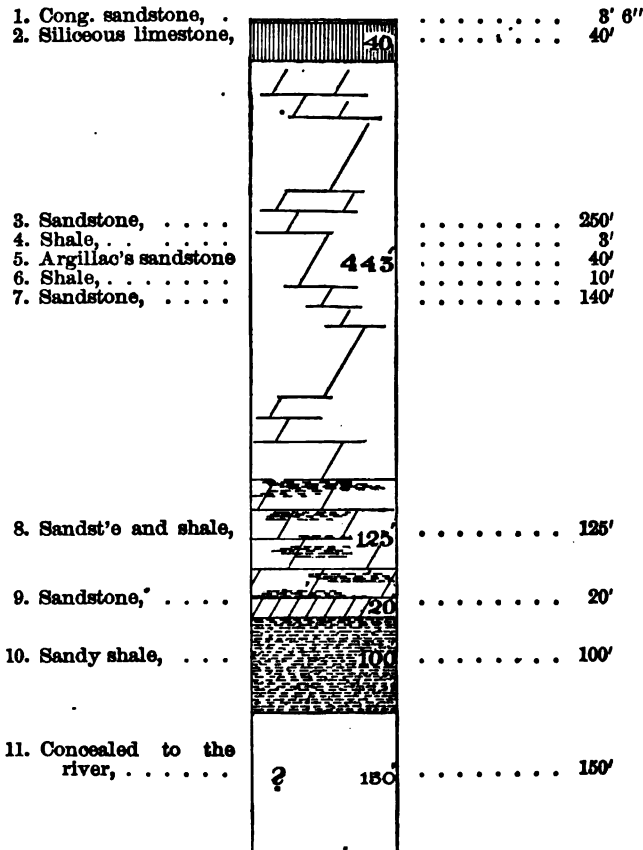
No. 1, the Pottsville (Seral) Conglomerate, is a very compact, moderately fine-grained sandstone, showing no conglomerate character whatever. The lower layers are made up of white sand, and include many stems of plants, whose exterior coats have been converted into coal.

Below the Conglomerate the exposure is very satisfactory, and the intervals occupied by Nos. 2, 3, and 4 should contain the Umbral iron ores of Fayette county. At several horizons in the upper 45 feet of No. 2, ore was seen, but it is so earthy that one may not speak with any degree of assurance respecting its value. It may be good, but no definite knowledge of its quality can be obtained without drifting to several feet from the out-crop. The little coals

found in these shales further south are absent here. The dark red shales above and below the upper Fossiliferous limestone contain much iron, but the hematite ore belonging to this horizon was not found. A few scattered nodules were observed, but if there be any bed it is hopelessly disguised by weathering.

The Fossiliferous limestones, Nos. 5 and 7, are siliceous. The upper one contains many individuals of *Athyris subquadrata* and a few of *Productus elegans*. No other species were seen. The lower bed is very sandy and is almost a calcareous sandstone. It contains *Athyris subquadrata* re-

Fig. 39.



Conemaugh Gap.

placed by calcspar. The siliceous limestone is but partially exposed, and shows the characteristic blue color when freshly broken. As at the southern localities, it soon parts with its calcareous matter on exposure to the weather, and becomes a loose grained sandstone.

The rocks below the siliceous limestone are not well shown in this gap. The great Pocono (Vespertine) Sandstone is seen rising out of the stream at a high angle, and soon mounts to the top of the hill. It is shown on the top of the ridge at several points where the roads cross, but the whole series is best seen in the gap of the Conemaugh, where the section is as represented in Fig. 39.

No. 1, seen also in the Loyalhanna gap, is a coarse sandstone, containing fragments of the underlying limestone, most of which are angular as though torn from a compact mass. The siliceous limestone is quarried near the watch-house, and shows a clean face of not far from 40 feet. The rock is light blue, excessively brittle, and breaks with a handsomely conchoidal fracture. The proportion of silica is very large, and the mass weathers to a rounded surface like limestone, but the outside portion for an inch or more usually consists of loose sand. When burned it yields a snow-white material, which, even when closely examined, seems to be only white sand ; but it contains sufficient lime to slake and to form a mortar. This rock is used by the railroad company for ballast.

The enormous Pocono Sandstone, Nos. 3 to 7, inclusive, forms a great wall alongside of the railroad. No. 3 is flaggy and curiously cross-bedded. No. 5 is somewhat argillaceous and tends to become shaly, while No. 7 is quite compact and in some portions is massive. Its face is shattered, so that the railroad company have been compelled to wall up many places on the cliff to prevent dangerous falls. In the middle and toward the base many of its layers are conglomerate, and the pebbles are frequently as large as a plum. Fragments of these layers lie on the hillside just east from a deep ravine, which marks the western side of Pack Saddle mountain. The base of No. 3 is the highest

rock passing over the arch. The axis crosses the railroad near the two hundred and ninety-eighth mile-post.

Below this sandstone, which dips at the rate of twelve degrees, is a mass of alternating shales and sandstones, the latter from one to three feet, and the former from one to twenty feet thick. The whole is characterless and has a dull grayish red color. No. 9 is a compact sandstone with a ten-inch layer of conglomerate near the middle. Pebbles are numerous throughout this stratum and occasionally are arranged in layers. The rock is a curious one and the principal conglomerate layer is distinctive, at once identifying it with the conglomerate observed on the National road at the very summit of the ridge. Underlying this are sandy shales of which 100 feet are exposed. These are made up of alternate hard and soft layers, so that the weathered surface is very rugged.

23. HEMPFIELD TOWNSHIP, OF WESTMORELAND COUNTY.

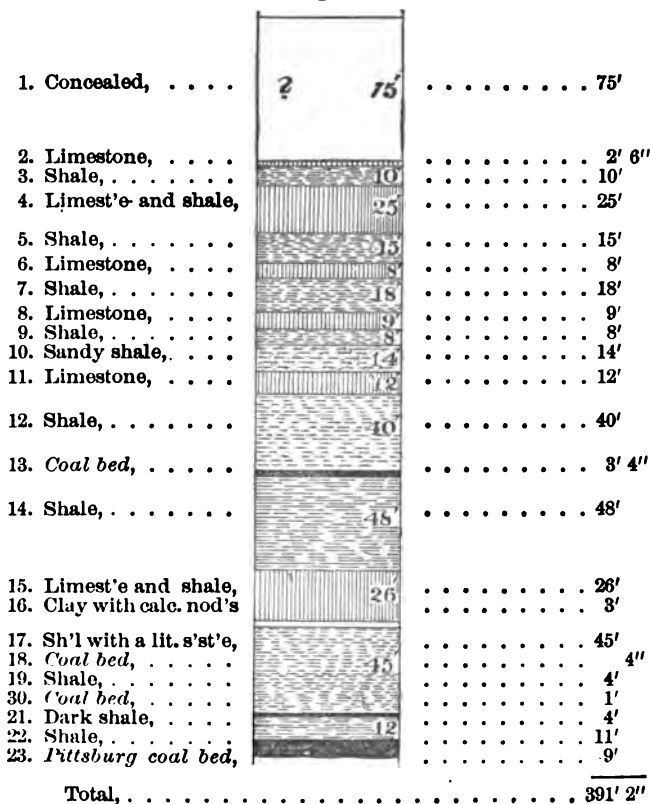
This township lies west from Unity and Mt. Pleasant, and south from Penn and Salem. The Greensburg synclinal enters about half a mile east from the township line, and crosses the Pennsylvania railroad at not more than 200 yards east from the tunnel at Greensburg. Southward from that it rapidly disappears, and on Sewickley creek its place is occupied by the Saltsburg anticlinal. That anticlinal enters the township about half a mile east from the Penn township line, and crossing the extreme north-west corner it passes into Penn township. It reaches Hempfield township again at Grapeville station, on the Pennsylvania railroad, and crosses the Greensburg pike, in the immediate vicinity of Grapeville village. It is still well marked on Little Sewickley creek, where it brings up the *Upper Freeport coal bed*; but near this line it is shifted eastward and crosses Sewickley creek, very near the mouth of Jack's run.

An extensive area of the upper coals, lying for the most part north from the Pennsylvania railroad, occurs in the eastern portion of the township in the Greensburg trough.

In this basin the eastern out-crop of the *Pittsburg coal bed* begins on Jack's run, at the county asylum farm, runs

northward, crosses the run above the Greensburg Coal Company's works, making a double out-crop there, and follows a north of east course to the Greensburg pike, which it reaches at two miles and a half from Greensburg. Thence it runs irregularly east of north, crossing the railroad just west from Georges station, and reaching Crabtree run, about two-thirds of a mile from the line of Salem township. There it passes into Unity township. The western out-crop runs west from the county farm for nearly two-thirds of a mile, showing a deep indentation, and thence goes north-north-west and north to the Greensburg and West Newton road, which it crosses at two miles from Greensburg. After a sharp fold to the south-east, it resumes the north-north-

Fig. 40.



Greensburg Section.

west course, reaching the Greensburg pike about a mile and a half west from Greensburg, and the Pennsylvania railroad just west from the tunnel. Its course is now east of north to the New Salem road, crossing the Harrison City road, near Mr. Shuey's, and that to New Salem, at Mr. Baer's. It there turns east and south, making a deep curve south-south-east to the Harvey's five-points road, whence its direction is rudely west of north to the line of Salem township, which it crosses at about two miles from that of Penn township.

Along the Pennsylvania railroad, from Georges station to the tunnel west from Greensburg, a very good section of the Upper Productive Coal Series, as it exists here, is given in Fig. 40:

No. 1 is the concealed interval at Greensburg, and exhibits no exposures of any kind. Nos. 2, 3, and 4 are seen in the tunnel cuts at Greensburg. In the cuts on the South-West Pennsylvania railroad, near the junction, and in the first cut east from Greensburg. No. 2 is a very fair limestone, but has not been burned. No. 4 is an impure rock, somewhat ferruginous, of a dull brownish color, breaks with an irregular fracture, and has a slightly granular structure. It contains a good deal of clay, and may be a fair cement rock. No. 6 is much superior to the last, and is much used. A quarry is largely worked alongside of the railroad-fill, east from Greensburg, and another on the pike, one-fourth of a mile further east. The same stratum comes up at the east end of the first cut from Greensburg, where it is quarried, and burned into lime. It is exposed on the roads leading from Greensburg to New Alexandria, and Congruity. It has been burned on Mr. Jennings' property, west from the borough, and that gentleman states that it yields a lime which is excellent for agricultural purposes.

No. 8 is not exposed on the railroad, east from Greensburg, but in the double cut beginning at the warehouse west from the station, it is a dull yellowish, slightly ferruginous rock, having all the external characters of a cement rock. No. 10 is shown in this cut as well as on the pike, both east and west from the borough. It is coarse, and

very ferruginous, weathering to a bright yellow. . No attempts have been made to determine its value for lime. The rocks, filling the interval between this and No. 8, are given as they appear in the first long cut west from Greensburg, but in the second cut east from the borough, they are represented by a flaggy sandstone, which has been quarried to a slight extent. This is clearly the friable sandstone seen on the pike about a mile east from Greensburg, which is so very friable that it is digged to procure sand for building purposes. Near the steam mill, at the southern end of the borough, there is a quarry in the same rock, which there shows the same characters. This rock is so soft, that one looking at the out-crop, might suppose it to be a recent deposit. The more so, as the most extensive quarry, if one may so use the term, occurs on one of the best marked terrace levels in the district.

In the third cut east from Greensburg, fragments of No. 11 occur on top of the hill, resting on No. 12, which there consists wholly of more or less sandy shale. Elsewhere, it seems to be always a flaggy sandstone, and as such it has been quarried in the second cut west from Greensburg. An exposure on the pike, just west from Greensburg, shows it to be a good flaggy rock. The coal bed, No. 13, seems to be thoroughly persistent. As exposed in the third cut east from Greensburg, it shows :

1. Carbonaceous shale,	5"	} 3' 4"
2. Coal,	1' 5"	
3. Clay,	1'	
4. Cannel shale,	6"	

The overlying shale, No. 12 of the section, is broken here by numerous vertical fissures, containing vertically laminated shale. The coal is very poor and slaty, and No. 4 is a cannel with a slaty structure, such as not unfrequently occurs in the Upper Coal Series. This bed is exposed on the pike and on the West Newton road west from Greensburg, as well as on the roads leading north from Greensburg. At all of these localities it seems to be thinner than on the railroad. The shale, No. 14, exists as such only in the third cut east from Greensburg. On the pike west from

that borough, and on the railroad near the tunnel, it is a handsome flagging stone, which has been quarried.

The limestone, No. 15, is a worthless mass. As seen in the third cut east from Greensburg, it consists of 19 feet of very coarse ferruginous limestone, resting on 6 feet of calcareous clay, below which is one foot of limestone. Near the tunnel west from Greensburg, it is exposed in a hollow, where it has the same character. There it seems to be little more than 50 feet above the *Pittsburg coal bed*. It is thoroughly persistent in the basin, being found at all localities where its horizon is exposed.

The little coals, Nos. 18 and 20, are really one, being found double only in the long cut west from Georges station. They are represented by a single coal bed, one foot thick, at a little way south from the track near the watering station. At the tunnel, west from Greensburg, this bed is 2 feet 6 inches thick and 18 feet above the *Pittsburg coal bed*. At 250 yards south from the track here it is mined, and has a thickness of 3 feet 6 inches. At the tunnel it is double, the layers being equal and separated by 6 inches of clay, but the parting is not persistent in this vicinity, being absent in several openings seen near the railroad. On the west side of the tunnel, the interval between this and the *Pittsburg coal bed* is only 9 feet. The bed seems to be thoroughly persistent, having been seen on the New Salem road, near Mr. Shuey's, on the road to Harvey's five points, near Mr. Kuhn's residence; on the Greensburg pike near Mr. Hughes' opening in the Pittsburg; in the cut, on the old Hempfield railroad route, near the blacksmith's shop, one mile west from Greensburg, where it is 3 feet thick; and near Mr. Iseman's house, on the southern out-crop of the *Pittsburg coal bed*.

Along the eastern out-crop openings in the *Pittsburg coal bed* are quite numerous. A small outlier on Mr. McIntyre's property, south from the county asylum, is mined, and on the extreme southern edge of the bed it has been opened by Mr. Bear. Near Greensburg are the mines of the Greensburg Coal Company, where the bed shows:

1. Roof division,	3'	} 12' 9" to 9' 10"
2. Main clay,	3' to 1"	
3. Lower division,	6' 9"	

The roof division consists of alternating layers of coal and clay, the latter extremely variable, but for the most part very thin. Its coal is handsome, but contains too much ash to be of any value. The main clay frequently becomes a horseback, cutting out two or three feet of coal, but such troubles continue for only a short distance, and cause but little annoyance. The benches in the lower division are 49, 3, 19, and 12 inches, with the partings very thin. Sulphur is present in small quantity, and the coal is of excellent quality, though somewhat brittle. The lower bottom bench is a poor material, much broken by vertical cleavages and thin slates. Ten bee-hive ovens have been erected for coking the slack. One clay vein has been found in this mine, which varies from 3 to 6 inches in width. The course of the main vein is north-east and south-west, but it throws off a spur at right angles toward the south-east; on each side of it the coal is curled and twisted for one or two feet, showing no regular bedding. Near the mouth of the pit, an awkward roll occurs in the bed. Entering, the coal descends with a dip of nearly seventeen degrees toward the south-east for a distance of about 50 yards, and then resumes its regular dip, rising toward the south-east. This fold seems to cross directly in front of the pit-mouth, for, on the opposite side of the run, there are several openings almost at water level, and dipping sharply toward the north-west. A similar roll occurs in Mr. Hammer's pit at a short distance south-west from the last, and is doubtless a continuation of this. The disturbance disappears at a little way north-east from the Greensburg Company's works.

On the road to Pleasant Unity, at about half a mile from the run, are pits belonging to S. Long, R. Lowry, and J. Rugb. At the last the section is:

1. Roof division—

Bituminous shale, .	6"	} 3' 4" to 5' 8"	} 11' 10" to 12' 4"
Clay,	4"		
Coal,	7"		
Clay,	5"		
Coal,	10"		
Clay,	1' to 1"		
Coal,	2' to 7"	} 2' to 2"	} 6' 8"
2. Main clay parting,			
3. Lower division,			

The lower division shows its benches, 48, 3, 8, and 18 inches, a material variation below the bearing-in. No clay veins have been found in any of these banks, one of which has been worked for more than twenty-five years. The dip is quite regular, being nearly three degrees in a north-west direction. The coal in all respects resembles that obtained at the Greensburg Company's mines.

The bed is well exposed in the railroad cut just west from George's station, where its section is:

1. Roof division,	8"	} 8' 5"
Main clay,	6"	
Lower division,	7' 8"	

The sudden decrease in the roof division is astonishing, but the thickness given prevails along the whole exposure in this long cut, and the main clay parting shows no perceptible variation here. In the lower division the benches are 24, 30, 3, 10, 7½, and 15 inches, the first two representing the breast or upper bench. In the Greensburg basin, a parting rarely occurs in this bench, but here it is well-defined and persistent. The fourth bench is the "brick," and the last two are merely subdivisions of the "lower bottom." North from this the only opening seen along this out-crop is that just east from Barnhart's mill. In it the roof division is not exposed, and the lower division shows a structure similar to that observed south from the railroad.

On the western out-crop, openings belonging to Mr. Kuhns, Mr. Lindsay, and Mr. Shuey, were seen north of the railroad. In these the bed shows a structure similar to that obtained at the tunnel west from Greensburg, where the section is:

1. Roof division—				
1. Bituminous shale,	3"	}	4' 10"	
2. Clay,	5"			
3. Coal,	2"			
4. Clay,	1' 3"			
5. Coal,	5"			
6. Clay,	1" to 6"	}	14' 2"	
7. Coal,	1'			
8. Clay,	2"			
9. Coal,	5"			
10. Clay,	2"			
11. Coal,	0" to 6"	}		
2. Main clay parting,				1' 6"
3. Lower division—				
Upper bench,	5'	}	7' 10"	
Coal and partings,	4"			
Brick and lower bottom,	2' 6"			

On the Greensburg pike, the coal is mined by Mr. Mathews, and at two openings on Mr. Hughes' property. The section is like that obtained at the tunnel. On the West Newton road it is opened by Mrs. Bierer, at whose bank the exposure is imperfect, but the roof shows 1 foot of slaty coal, and the lower division is divided into five benches, 15, 38, 3, 8, and 16 inches, giving in all a thickness of 6 feet 9 inches. The main clay parting is a black shale 1 foot 6 inches thick. Opposite this property there are two small outlying patches, which have been mined. Southward the bed has been opened by Mr. Goodling and Mr. Detar, at whose pits the roof is concealed, and the lower division shows no material difference from the section just given. An outlying area of small extent lies west from the road here, on which are several old openings—all of them deserted. The coals from the banks on this out-crop is clean, but is brittle, though much less so than in the Blairsville basin. By careful handling a large proportion can be brought down as lump coal.

In the western part of the township, there is a portion of the Upper Coal area belonging to the Lisbon (Irwin) trough, and the eastern out-crop of the *Pittsburg coal bed* in that basin crosses the township. This line enters at the Pennsylvania railroad, near Penn station; goes east for half a mile, and then turns south, crossing the Greensburg pike at half a mile east from Adamsburg. Thence the line has an

irregularly west of south course, but shows some deep indentations northward, and crosses the Little Sewickley creek about three-fourths of a mile east from the township line. South from that creek, it passes east of south nearly to the Greensburg and Madison road, but recurving, it returns almost to the creek. Again it goes irregularly south and south-west, crossing the Greensburg and Madison road half a mile east from Madison, and passing into Sewickley township about two-thirds of a mile south from that village.

On the Pennsylvania railroad, the *Pittsburg coal bed* is mined extensively by the Penn Gas Coal Company. In the works belonging to this company, the bed is troubled by clay veins, and by serious irregularities in dip. One large "swamp" is well exposed along the tramway leading from the pits to the railroad. The structure of the bed is shown in the following section, obtained at Mr. Kimbly's opening:

1. Roof division—

Coal,	1'	}	4'	}	11' 10"
Clay,	4''				
Coal,	2'				
Clay,	2''				
Coal,	6''				
2. Main clay parting,	1'				
3. Lower division,	6' 10''				

The roof is not fully exposed, and probably 1 foot should be added. The lower division shows the benches 43, 24, 12, and 24 inches. The thickness of the lower bottom is given according to the statement of the diggers, but is no doubt too large, as the bench has not been found more than 18 inches at any locality on this side of the trough. The best coal comes from the top bench, which has no persistent binders of clay, and but little pyrites. A thin pyrites streak is commonly found in the brick, which varies little from half an inch in thickness. The coal is very handsome, and is easily mined, being brought down in large lumps by wedging. The out-crop of the bed passes directly under Mr. Kimbly's house. Several other banks in the immediate vicinity of this were examined, but they show no material difference.

On the road leading from Adamsburg to Middletown, the *Pittsburg coal bed* is reached at almost a mile and a half from the former place, on the properties of Mrs. Baughman and Mr. M. E. Erhart. The roof division is not exposed at either of these banks, and the lower division has a total thickness of 6 feet 3 inches, in four benches, 45, 3, 12, and 13 inches. The parting under the bearing-in being 2 inches thick. About a mile from these openings, are those belonging to Mr. M. Chroushore and J. Iseman, which show a similar section, the roof division in each case being concealed. South from the Little Sewickley creek, several openings were seen, but before reaching the Greensburg and Madison road, there are none which show the roof. Mr. J. Brisbin's bank, near that road, shows the lower division 6 feet thick, and the main clay 6 inches to 1 foot. The roof is concealed by debris of the Pittsburg Sandstone, which, as exposed here, is a flaggy rock, without regular bedding. On the other side of the Greensburg road, the *Pittsburg bed* is mined by Mr. W. Brisbin, at whose opening the section is:

1. Roof division,	2' to 3'	} 10' 9"
2. Main clay parting,	1' to 6"	
3. Lower division	7' 3"	

The roof is not fully exposed, but, where it is seen, it appears to consist chiefly of coal, the clays being very thin. The lower division shows five benches, 50, 3, 18, 12, and 4 inches, the latter two being merely sub-divisions of the lower bottom bench. No clay veins or horsebacks have been found in these works, which are very extensive. Just east from Madison, there are several openings, which show the lower division like the last given. At one of them, a fall near the mouth exposes the roof division, with the following section:

1. Sandstone,	—	
2. Shale,	6'	
3. <i>Pittsburg coal bed</i> , Roof Division—		
Carbonaceous shale,	5"	} 3' 9"
Coal,	6"	
Clay,	10"	
Coal,	2'	
4. Main clay parting,	1' 3"	

The bottom layer of coal is slaty, so much so as to be worthless. Here, as at many localities, the main clay parting is a laminated shale at the out-crop, while within it becomes an apparently structureless clay, much slickensided.

In the south-eastern portion of the township, there is a small area of the *Pittsburg coal bed*, belonging to the Blairsville trough. The out-crop of the coal barely enters from Mt. Pleasant township and quickly curving, passes out into East Huntingdon. There the coal is mined by Mr. Simpson and Mr. Shields, and shows a section similar to that found at the openings in adjoining portions of Mt. Pleasant township.

Just west from Penn station, the Pennsylvania railroad enters a deep cut. At the east end this shows:

Sandstone, 60 feet; sandstone, with streaks of coal, 6 feet.

At a few rods within the cut, the sandstone containing the streaks of coal goes under the track, and within a few feet beyond, towards the west, a limestone, not far from 8 feet thick at the greatest, suddenly comes in. This lasts for, say, twenty yards, when it is cut off as suddenly as it came in. Following the side track, leading to the tippie of the Foster mine, and beginning at the east end of the cut, one sees the same phenomenon. The limestone comes in, and continues quite to the tippie, beyond which the hill is cut off, and the limestone or its place is not exposed. It is very clear that the limestone has been removed by erosion, occurring not long after its formation. Going still further into the cut, one finds the sandstone itself cut away, and replaced by a soft, yielding, sandy shale. This is a marked feature in the cut, and led one of the engineers to remark, that, if the railroad had run the other way, the cost of making the cut would have been much less. Without doubt, then, we have here the evidences of two times of erosion, one to form the gap in which the sandstone is deposited, and the other to make the gully in the sandstone, now filled by the shale. This limestone is the representative of the Great Limestone, which, in this basin, is sometimes known as the 120-foot limestone, since it occurs at nearly that distance above the *Pittsburg coal bed*, in the Westmoreland company's shaft.

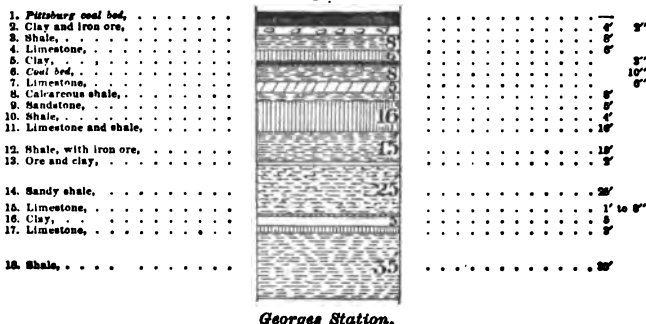
The little coal bed, of which the fragments are scattered in the lower 6 feet of the sandstone, is clearly the *Redstone*, known as the "80-foot" coal.

On the Adamsburg and Middletown road, a coal blossom is seen on the first summit, separated by 25 feet of shaly sandstone from a thin limestone, and at a short distance further on the Great Limestone is partially exposed. The interval between the two limestones could not be made out with exactness, but it does not seem to be more than 90 feet. The upper is the Waynesburg Limestone, and the coal bed above it is the *Waynesburg*. Both of these limestones are burned for lime. The upper one is not more than 5 feet thick, while the lower one is exposed at one locality for 12 feet.

The "80-foot," or *Redstone coal bed*, is exposed on the Greensburg and Madison road, near Mr. Brisbin's bank, where it is said to be 3 feet thick. The Great, or "120-foot," limestone is shown in the road, between this and the village of Madison. It is somewhat ferruginous, but the yellow coat is always thin, even on long weathered specimens, and the interior is brownish gray. Between it and the *Redstone coal bed*, there is a flaggy sandstone, and the interval between the *Redstone and Pittsburg* is wholly sandstone.

Along the Pennsylvania railroad, the upper portion of the Lower Barren Series is very fairly exposed, both in the cut west from Georges station, and in that at the tunnel, west from Greensburg, but the rocks still lower in this series are nowhere exposed in detail within this township. The sec-

Fig. 41.



tions obtained at these localities are given in full, in order to show the marked variations characterizing this series. Fig. 41 is from Georges station, and Fig. 42 is from the tunnel:

Fig. 42.

1. <i>Pittsburg</i> coal bed,		5'
2. Clay and iron ore,	10	10'
3. Shale,	2	2'
4. Limestone,	3	3'
5. Clay,	8	8'
6. Limestone,	12	4'
7. Clay, with nodular limestone,	25	12'
8. Micaceous shale,		28'
9. Clay,		2'
10. Limestone,	15	1' 6"
11. Variegated shale,		15'
12. Limestone,	12	2' 6"
13. Shale,		15'

Tunnel West from Greensburg.

At both localities, ore is found in the shaly clays underlying the *Pittsburg* coal bed. At the former, it is in three layers, 1, 6, and 3 inches respectively. The 6-inch layer consists almost equally of ore and clay, and the total of ore in the three layers is barely 6 inches. At the tunnel there seems to be but one layer, 3 inches thick, with nodules scattered irregularly through the clay. The material is of no value. Diligent inquiry was made at every opening in the *Pittsburg* coal bed seen in the township, but the ore seems to be absent, or, if present, undiscovered at all of them. In the western portion of the township, in the Lisbon (Irwin) trough, a thick limestone comes directly under the coal, and is probably the same with No. 4 of the sections, which at most localities is a good limestone for lime, and is one of the most persistent strata of the series. The little coal bed, No. 6, of the first section was not seen in the second. It is a rich carbonaceous shale, and is seen in many localities at from 10 to 25 feet below the *Pittsburg* coal. A limestone, holding the place of No. 11 of section one, is quarried and burned into lime on the Greensburg pike, at about half a mile east from Adamsburg. None of the other strata in the sections presents any noteworthy feature.

On the railroad, about a mile and a half east from Grapeville station, a coal bed, 2 feet 6 inches thick, has been mined by stripping. Though no exposures occur in the vicinity to render the identification positive, this is to all appearance

the *Barton coal bed*, being about midway between the *Pittsburg coal bed* and the Mahoning Sandstone.

On the Greensburg and Pittsburg pike, exposures of the Lower Barren rocks are not found in profusion. On the first summit west from the out-crop of the *Pittsburg coal bed*, is a mass of sandstone and shale, and near Grapeville fragments of the Green or Crinoidal Limestone are seen, though not in place. This limestone is shown in place on the hill west from Grapeville, and is there embedded in a mass of variegated shales and clays. At 40 feet above it, is a flaggy sandstone, which may represent the Morgantown Sandstone. A similar exposure occurs on the same road, just east from Grapeville. No other exposures were found on this road.

The Lower Productive Coal Series is exposed in part on Sewickley and Little Sewickley, in each case under the arch of the Saltsburg anticlinal.

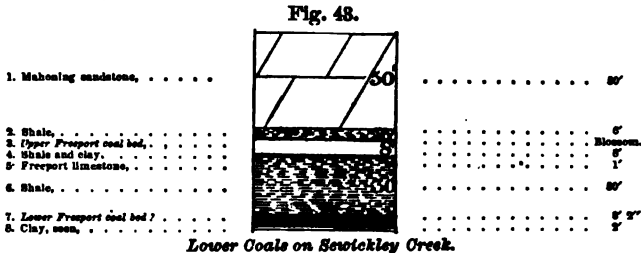
On Little Sewickley creek, beginning about half a mile below Grapeville, and continuing along the stream for nearly two miles and a half, is the area of a coal bed, which seems to be certainly the *Upper Freeport bed*. It lies 260 feet below the Green Limestone, as found on the Greensburg pike east from Grapeville, and nearly in the line of strike from Mr. Hanes' opening in the coal. But aside from this, nothing could be obtained, as the whole region is deeply covered by debris. The coal bed itself was traced only by means of its bench, and the area given on the map is partly conjectural. In early times the bed was mined on Mr. Hanes' property, about a mile below Grapeville, but all the openings were deserted long ago. At one of them an imperfect exposure still remains, which shows:

1. Coal, and black shale,	3'	} 10' 6"
2. Clay,	2' 6"	
3. Coal,	5'	

No. 3 is said to be 6 feet thick, making the whole thickness of the bed 11 feet 6 inches. The upper division is made up of coal and slate, so mixed as to render the whole mass worthless. The lower division at this opening consists of very poor coal, but an old pit on the other side of the hill is said to have yielded a very good coal when it was worked

forty years ago. The coal from this bed is no longer used, and the inhabitants prefer to haul their coal from openings in the *Pittsburg*, which are within easy reach on each side.

On Sewickley creek, the exposures are much more satisfactory. For several miles the stream flows irregularly through the arch of the Saltsburg axis, and so keeps the Freeport Group in sight. The section obtained near the mouth of Jacks run, not far from the crest of the axis, is shown in Fig. 43:



The top of the series comes up from the creek, near Chamber's mill, where the Mahoning Sandstone forms a handsome bluff. At Ruff's salt-works, a well was bored to the depth of 450 feet, stopping in the "80-foot rock" or the Pottsville (Seral) Conglomerate. No record was kept of the boring, but Mr. Ruff says that, beginning in a coal bed 5 feet thick, he found a second at 30 feet, and a third at 65 feet. In the boring about 200 feet of sandstone were pierced and the well stopped in a honeycombed rock, the Conglomerate. When first obtained, the brine had a strength of ten degrees, but the works lay idle for a number of years, and when pumping was resumed the strength was only 3 degrees. After some time it became 6 degrees, which is the present grade. The quantity of brine is sufficient for the manufacture of twenty-five barrels of salt each day.

The top coal, referred to by Mr. Ruff, is unquestionably the *Upper Freeport*. It is not exposed in the immediate vicinity except by its blossom. Mr. Ruff states that it is a mixture of coal and slate, but in what proportion he is unable to tell. The second or *Lower Freeport coal bed* rises from the creek just above the salt-works. At Mr. Hill's

bank, on the opposite side of the stream, it shows a thickness of 4 feet 7 inches, and consists of :

1. Black shale,	2"	} 4' 1"
2. Coal,	10"	
3. Clay,	2"	
4. Coal,	1'	

Six inches of sandstone rest on the bed, above which is a shale. The coal evidently contains much pyrites, and the water issuing from the pit is heavily charged with the oxide. Near Cochran's old salt-works, another opening shows a very different structure, the section being :

1. Shale,	2'	} 10"
2. Sandstone and iron ore,		
3. Black shale,	4"	} 3' 10"
4. Coal,	1' 4"	
5. Clay,	1"	
6. Coal,	1' 2"	
7. Clay,	2"	
8. Coal, seen,	10"	

The coal is rather slaty, and, if one may judge from the quantity of cinder strewn in the road, is very apt to clinker. The fuel for the old salt-works was obtained here. Between this and Mr. Hill's opening, a number of deserted pits were seen, chiefly on the property of Col. Painter.

The section first given was obtained along side of the South-west Pennsylvania railroad, near the site of deserted salt-works on the west side of the creek. There the Mahoning Sandstone is fairly exposed in the bluff and reaches up to the Greensburg road. Portions of it are in layers two to four feet thick, which are compact and well fitted for building purposes. At one time the *Upper Freeport coal bed* was mined here to obtain fuel for the old salt-works, but the openings have all fallen shut so that no measurements can be made. The Freeport Limestone, one foot thick, is exposed above the railroad cut here, and seems to be a very inferior rock. Over the same cut is a deserted opening in the *Upper Freeport coal*, the entry to which passed directly under the Greensburg road. In the cut the *Lower Freeport coal bed* is exposed as follows :

1. Coal,	8'	} 5' 4"
2. Clay,	1"	
3. Coal,	9"	
4. Clay,	2"	
5. Coal,	1' 4"	

The measurement given shows the extreme thickness observed ; but the bed is extremely variable in structure and thickness, changing in the latter respect as much as 2 feet within two yards. The coal is clearly of very inferior quality. Along the creek the blossom of this bed was seen at a number of places. In general characters it bears close resemblance to the *Upper Freeport*, so that where the Freeport Limestone is not exposed, one is often at a loss to determine which of the beds is before him. The *Upper Freeport* is mined back of Paintersville, and is available along Wilsons run to within a mile of the township line. At Paintersville, it is exposed along the railroad under sandstone and shale, and at a short distance further south a limestone 8 feet thick is seen at about 40 feet above it. This bed exhibits strange variations, being only two feet thick at Paintersville, while at other localities it often becomes 5 feet.

At Paintersville are Col. I. Painter's salt-works. The well was recently reamed out, but the record has already been lost. Imperfect data still remain on the derrick, and the following partial section was made out :

1. Lower Freeport coal bed,	2'
2. Gray sandstone,	48'
3. Unknown,	3'
4. Shale,	38'
5. Gray sandstone,	40'
6. Black shale,	23'
7. Unknown,	7'
8. Soft shale,	26'

The rest of the section could not be deciphered. At 314 feet coal is believed to have been struck and at 357, the Conglomerate, or rather the salt-rock was struck, making the interval from the Mahoning Sandstone about 400 feet, which is very nearly the same as at Ruff's salt-works. This conglomerate is 73 feet thick in this well, and is known throughout this region as the "80-foot rock." It is

the great repository of brine. In the upper well here it contains few pebbles, but in the lower well pebbles were found abundantly. The brine at these works is 4 degrees strong, but the expectation is that the strength will increase in time, as the works have not been in operation continuously. The capacity of the works is 15 barrels per day, but the brine is said to be in sufficient quantity for the manufacture of 40 barrels.

Lower down the creek the *Upper Freeport coal bed* and the Freeport Limestone were seen in a bluff at the cross-roads, near the old carding-mill. Thence they remain in sight for fully a mile, when the latter passes under the stream. The coal is above the water for half a mile further, and the Mahoning Sandstone goes under at not more than two-thirds of a mile above Waltz's mill. About a mile below the old carding-mill, two openings in the *Upper Freeport coal bed* were seen, belonging to Colonel Fulton and Mr. D. Back. The measurements obtained here are as follows:

1. Coal,	3' 6"	2' 10"
2. Clay,	1" to 3"	1" to 3"
3. Coal,	1' 6"	1' 5"
4. Clay,	—	1"
5. Coal,	4"	5"

At both pits the coal is prismatic, and much care is required to make lump coal. The top, for from 4 to 6 inches, is somewhat bony, and is not removed. Numerous thin slates occur throughout; soot veins are common, and pyrites is abundantly distributed. Piles of cinder on the site of the old salt-works here fully show the capacity of the coal to form clinker. It is said to be very hard on iron. The thickness of the bed is somewhat variable, owing to irregularities in the sandstone roof.

The Mahoning Sandstone rests directly on the coal. It is flaggy, and seems to have been quarried to some extent. Numerous impressions of stems were seen in it, many of which are casts, a condition by no means common further south in this district. Near Colonel Fulton's opening, the Freeport Limestone is seen 12 feet below the coal and 18 inches thick. It is in two layers, respectively 12 and 6

inches thick ; the former yields a good lime for agricultural purposes, but the latter is too ferruginous for use. Between the coal and the limestone there seems to be nothing but clay.

24. SALEM TOWNSHIP, OF WESTMORELAND COUNTY.

This lies north from Hempfield township. It is drained at the east by tributaries to the Loyalhanna and at the west by Beaver run and its tributaries. The Greensburg synclinal enters at the Loyalhanna, opposite the mouth of Tub-mill run, and follows a direct course from that point toward Greensburg. The Saltsburg anticlinal enters from Loyalhanna township, at about two miles and a quarter north-west from the corner of Derry township, crosses the Conemaugh pike at or very near Harvey's five points, and passes out into Hempfield within two-thirds of a mile from the line of Penn township. The Lisbon (Irwin) synclinal enters near the extreme northern corner, passes near school-house No. 1, and goes out into Franklin township, near the angle north from New Salem. The section extends from nearly 300 feet above the *Pittsburg coal bed* to the middle of the Lower Barren Series.

The upper coals occur here in both the Greensburg and Lisbon (Irwin) synclinals. In the former, the coal area is a compact body at the south-east, while that in the latter is broken up into several areas in the north-western portion of the township.

In the Greensburg area, the eastern out-crop enters the township on Crabtree run, from Unity township, at somewhat less than three-fourths of a mile from the corner of Hempfield. Thence it follows a very regular north-east course, showing only slight indentations to within half a mile of New Alexandria, where it is turned westward, and follows an irregular course to the Conemaugh pike, which it crosses at a mile and a half from New Alexandria. It lies near the pike for about a mile, crossing it twice within that distance, and at half a mile from Kepple's run it turns south-south-west. It retains this direction for nearly two miles, and then bends westward to the road leading from

Harvey's five points to Greensburg, which it crosses at barely two miles from the former place. In this portion the line is very crooked, and the scale of the map does not admit of representing the sinuosities in detail. On the west side the line is almost equally tortuous, twice touching the road before reaching the line of Hempfield township, which it crosses at a little more than two miles from the Penn township line.

On the eastern out-crop, the bed is mined by Mr. Cook and Mr. Hickenlooper, and on the northern out-crop by Mr. Shields and others. On the Greensburg road, leaving the Conemaugh pike about a mile west from New Alexandria, the following section was obtained :

1. Pittsburg sandstone,	10'
2. Shale,	9'
3. Pittsburg coal bed—	
Roof division,	2'
Main clay,	1'
Lower division,	6' 6"
	} 9' 6"

The whole of the lower division is not exposed, and it is probably 7 feet thick. The roof shows two coals, 12 and 10 inches, separated by 2 inches of clay. In the lower division, there is no persistent parting in the upper or breast bench. The clay over the "bearing-in" is nearly 2 inches thick. The "bottom," as far as seen, is 24 inches thick, and shows no positive parting to separate the "brick" from the "lower bottom." On the western out-crop, openings were seen belonging to Mr. Denholm, Mr. Dickie, Mr. Hoover, Mr. Baker, Mr. C. Smith, Mr. Shaw, and Mr. Horner. At Mr. Denholm's, the roof division consists of 1 foot 6 inches of slaty coal, and the main clay parting has the same thickness. The variations in the roof are very great, but the lower division is quite regular. The following measurement was made at Mr. Horner's bank, and is characteristic of the bed along the western out-crop :

1. Shale, seen,	6'
2. Pittsburg coal bed—	
Roof division,	2' 5"
Main clay,	1' 2"
Lower division,	7' 7"
	} 11' 2"

The roof shows 2 inches and 12 inches of coal separated by 12 inches of shale. The main clay parting is a laminated shale near the out-crop, as is so often the case in this basin, but inside the bank it seems to be a structureless, slicken-sided clay as in the other basins. In the lower division, the several benches are distinct and measure 49, 3, 8, and 20 inches. At all of the openings the coal is handsomely irised. Pyrites occurs occasionally in lumps, but not in large quantity, and the coal appears to be very clean. It is somewhat brittle, but much less so than that in the Blairsville basin, and at several of the openings on the western out-crop it is tough enough to bear shipping. The best coal is at the top of the breast. No troubles occur here except slight swells of the main and underclays, which cause little inconvenience.

The eastern out-crop of the *Pittsburg coal* in the Lisbon (Irwin) basin, enters the township with the Salem and Boquette road. It lies close to that road, crossing and re-crossing it, runs just east from the main street in New Salem to the forks north from the village, where it crosses the street, and thence runs almost parallel with the Freeport road, to the line of Franklin township. Between the Freeport road and Beaver run there is an irregular area of considerable size, which begins just north from New Salem, and continues almost to Youngs run. In this portion of the basin the openings in the coal are numerous, but the bed shows only slight variations in structure. The roof division contains one or two layers of coal, in all, from 10 to 15 inches thick. The character of the lower division is shown in the following section, obtained at the mine in New Salem, belonging to Messrs. Hugus & Job:

1. Upper bench or breast coal,	3' 11"	} 6' 5"
2. Bearing-in and partings,	4"	
3. Brick bench,	1' 2"	
4. Lower bottom bench,	1'	

The top of the breast coal for 5 inches is bony, and is not mined, so that the available thickness, deducting this with the bearing-in and the worthless lower bottom, is but 4 feet 8 inches, which seems to be the average in this vicinity.

The roof is very secure: in this mine it has few supports, and is still sound in the long entries, though it has been standing for forty years. A fall rarely occurs.

Between the two forks of Beaver run, uniting at Tree's mill, there are some small patches of coal belonging to the Lisbon area. The principal one begins at about one-third of a mile east from the mill, and has a longer diameter of nearly a mile, in a south-east direction. It embraces parts of farms belonging to Mr. Tree, Mr. Stout, and Mr. Ramsay. Another, but much smaller patch, is seen on Mr. Klingensmith's farm, very near the last. Besides these, there is an insignificant one on Beaver run, somewhat more than a mile below Tree's mill. The section at Mr. Stout's opening is:

Roof division, 2 feet; Main clay, 1 foot 3 inches; Lower division, 7 feet 9 inches; Total, 11 feet.

The roof division is not fully exposed, and only about 10 inches were seen, so that the thickness is given in accordance with the statement of Mr. Stout. It consists almost wholly of coal, which is said to be very good, though soft, and containing rather more ash than that from the lower division. The latter shows the benches 59, 4, 10, and 18 inches. The brick is double, each portion coming out in blocks. No troubles occur here, aside from petty swells of the main clay.

An area of considerable economical importance, and belonging to this same basin, lies east from Beaver run, and reaches into Loyalhanna and Bell townships. From Bell, the out-crop of the coal enters Salem, very near the western corner of Loyalhanna, and follows an almost southerly course for more than a mile, when a deep indentation is made in the line, carrying the coal out-crop eastward more than half a mile, to near school-house No. 1. Returning, it runs southward for nearly a mile, and then eastward, crossing the Saltsburg and New Salem road at Mr. H. Jones' residence, and reaching the Greensburg and Apollo road at McCutchin's store. Thence it follows an irregular course, eastward and northward, until it enters Loyalhanna township alongside of the Saltsburg and New Salem road. Near

the border of Bell township it is mined by Mr. Rugh, Mr. Bronthaver, Mr. Brown, and further south by Mr. Jones. The last opening shows :

1. Laminated shale,	5'	
2. Roof division,	1'	} 9' 9"
3. Main clay parting,	1'	
4. Lower division,	7' 9"	

No. 1 is not fully exposed toward the base, and it seems to contain some coal, or black shale. The roof division, as given in the section, consists wholly of coal. The benches in the lower division are 60, 3, 12, and 18 inches. The bed is very regular, and the coal seems to be quite clean. No troubles have been found in this pit, but at one near by there is a clay vein 6 inches thick, and at Mr. Brewer's opening, a spar of the main clay, 5 feet wide, cuts out the coal to the bottom. Aside from these no troubles exist, except insignificant swells of the main clay.

On the eastern and southern edges of the coal, openings were seen belonging to Mr. McCutchin, Mr. Bort, and Mr. Willard. Mr. Bort's opening shows :

1. Roof division—		
Coal and shale,	1' 8"	} 1' 11"
Coal,	5"	
2. Main clay parting,	10"	} 10' 7"
3. Lower division,	7' 10"	

In the lower division the benches are 56, 3½, 8, and 26 inches, and there seem to be two persistent partings in the lower bottom. The "brick" is almost a true cannel. The coal is hard throughout, and blasting is necessary. It is clean, and the tarry layers are beaded.

Within the Lisbon (Irwin) trough, the upper rocks are for the most part concealed. On the Freeport road, north from New Salem, the *Redstone coal bed* is seen in the road, at 65 feet above the *Pittsburg*, and under it there seems to be some ferruginous limestone. In the shales overlying the *Pittsburg coal*, there is seen, in the same neighborhood, a mass of dark shale, at from 12 to 15 feet above that coal, which appears to hold a thin coal bed, but the exposure is not sufficiently clear to decide the matter. In the Greensburg trough, no connected section of the upper rocks could

be made out, but all the limestones, given in the railroad section of Hempfield township, were observed on the several roads, and some of them are burned into lime for agricultural purposes. On the road from Greensburg to New Alexandria, as well as on that to Harvey's five points, the upper coal of the Hempfield section is occasionally exposed by its blossom, and on the latter road the blossom of a still higher coal bed was observed, but its relations could not be determined.

Outside of the areas already described, the surface rocks of the township belong to the Lower Barren Series. Along the Conemaugh pike, exposures are few, and the cuts are, for the most part, overgrown with vegetation. The Green or Crinoidal limestone was seen on the Greensburg and New Salem road, half a mile from the former place, and 260 feet below the *Pittsburg coal bed*. A short section was seen here, as follows:

1. Sandy shale,	40'
2. <i>Barton coal bed</i> ,	10''
3. Shale,	25'
4. Crinoidal limestone,	3'

On this road, the *Barton coal* was again seen, two miles further south. Above the section, the Morgantown Sandstone was seen, and No. 1 of the section passes imperceptibly into it. The Crinoidal Limestone is imperfectly exposed on the road from Harvey's five points to Tree's mill, and at that mill, the Morgantown Sandstone is a massive rock, of which 35 feet are shown. Somewhat more than half a mile further down Beaver run, the *Barton coal bed* is reached, and is reported to have a thickness of four feet. At one time it was mined to a slight extent, but the openings have all fallen shut. It occurs on the properties of Col. McQuaid and Mr. Ringer. At the latter locality, the Morgantown Sandstone is exposed.

25 AND 26. LOYALHANNA AND BELL TOWNSHIPS, OF WESTMORELAND COUNTY.

For the sake of convenience, these two townships are described together, since an area of the *Pittsburg coal bed* is cut in two by the line between them. They lie north from

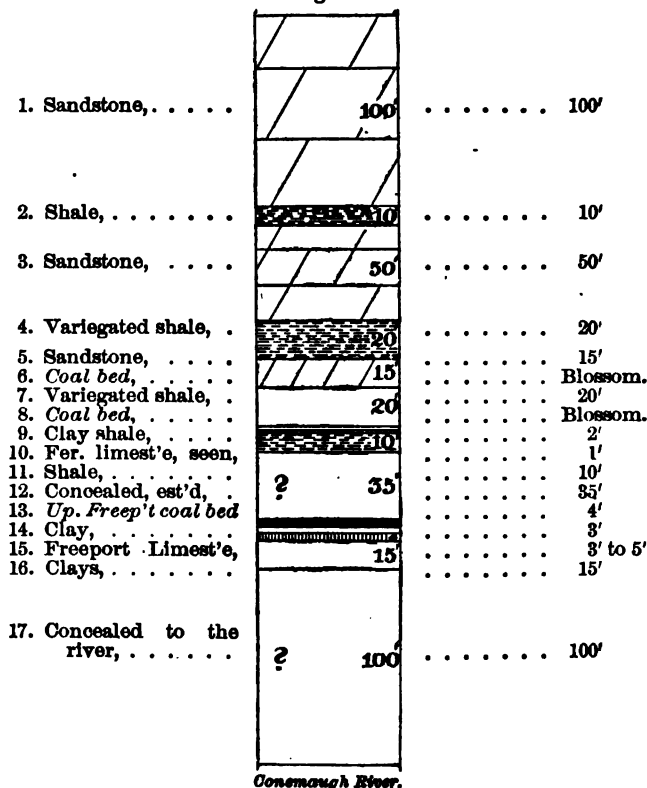
Salem, and front on the Conemaugh river. Through the former the Loyalhanna flows, and is crossed by the Saltsburg anticlinal, at Mr. James Snodgrass' mill. The western boundary of the latter is Beaver run, which is crossed by the Waynesburg (Roaring run) anticlinal, near Reed's mill. The section extends from and about 150 feet above the *Pittsburg coal bed* to 110 feet below the *Upper Freeport coal bed*, in the former, and to somewhat more below the same bed in the latter.

In Loyalhanna township, the hills outside of the Upper-Coal area are composed of the rocks of the Lower Barren Series, those belonging to the Lower Productive Coal Series being found only along the Loyalhanna and the Conemaugh, in the vicinity of the Saltsburg axis. Along the Saltsburg and New Salem road, the Morgantown Sandstone and the *Barton coal bed* were seen, at about two miles from the former place. The sandstone is flaggy, but forms cliffs for nearly a mile along the stream. The *coal bed* is very thin, and shows an insignificant blossom. Along the hill-road, from Saltsburg to New Alexandria, no exposures occur.

On the Conemaugh, the section shown in Fig. 44 was obtained, beginning at the mouth of the Loyalhanna, opposite Saltsburg, and ascending the river to the axis just above White's station, on the West Pennsylvania railroad. A portion of the section was obtained in Indiana county, as the railroad cuttings are extensive on that side of the river.

The sandstone, No. 1, appears as a cliff directly opposite Saltsburg, and is constantly in view up the river on one side or the other to the crest of the axis, and opposite White's station it forms an imposing cliff on the summit of the hill. It is a magnificent rock, in layers from 10 to 15 feet thick, most of which are of excellent quality, and would prove durable as building stone. At the same time, like all the sandstones of the Lower Barren Series, it is variable in structure, and at Saltsburg it abruptly changes into a sandy shale. At the mouth of the Loyalhanna the rock is homogeneous throughout, but further up the river it shows layers of conglomerate near the base, the included fragments belonging to an iron ore occurring there in the shale below the sandstone.

Fig. 44.



The shale, No. 2, is dark and argillaceous. Opposite Saltsburg it shows occasional nodules of iron ore, but at a little distance up the river the ore becomes a compact layer which, judging from an exposure in a cut on the Indiana side, is of some local value. It is not persistent, for at a mile above Saltsburg only a few scattered nodules were seen. The other sandstones of the section are marked features in the hills on both sides of the stream above Saltsburg. The parting shales are so insignificant as to form only small sloping benches on the hill sides, so that one passing along would not hesitate to regard the bluff as an unbroken mass of sandstone, from No. 1 down to No. 5 inclusive.

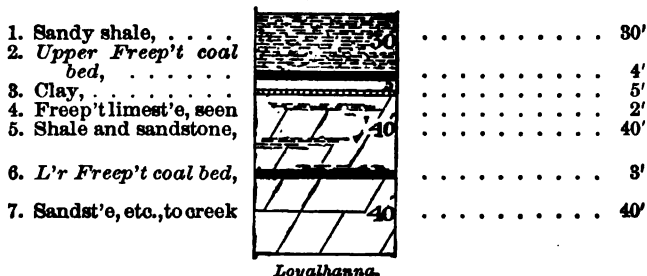
The limestone and ore, No. 10, evidently represent the Johnstown ore bed. The limestone is ferruginous through-

out, and the nodular ore resting on it is apparently of by no means inferior quality. It is not well exposed on the south side of the river, and is best seen in a cutting on the West Pennsylvania railroad, just below White's station.

The *Upper Freeport coal bed* comes up from the river at a short distance below White's station, rises slowly to the crest of the axis at the stone house above the station, and thence falls gradually towards the river, under which it passes near Kelly's station. At one time it was mined extensively and the number of deserted openings along the river is very great; but on the Westmoreland side of the stream no works were found in operation. The bed is said to be about 3 feet 8 inches to 4 feet thick, and to show a parting of one inch at a few inches below the middle. The coal is reported to be of quite inferior quality, the comparison being made with that from the *Pittsburg bed*.

The Freeport Limestone varies from 3 to 5 feet, is cream-colored, and evidently somewhat argillaceous; but it is burned for lime and is said to yield a very fair article. Underlying it is a mass of clays 15 to 20 feet thick, containing two thick layers of superior compact or indurated fire-clay. These were formerly digged, but for some reason the work has been abandoned. Below this there are no exposures. Diligent inquiry was made, but no person was found to whom the existence of the *Lower Freeport coal bed* is known. If that bed be present here, it must be very thin, as its blossom has never been seen. There seems to be no coal bed near the river surface, and the Ferriferous Limestone is absent or below the bed of the stream.

Fig. 44 a.



At the mouth of the Loyalhanna the sandstone, No. 1 of the section, is well exposed, and continues in sight for fully a mile up the stream. At somewhat less than half a mile below the ford, the *Upper Freeport coal bed*, under the influence of the Saltsburg axis, rises from the creek. The section here, as nearly as can be made out, is shown in Fig. 44a.

The intervals are estimated from exposures along the stream, as direct measurements cannot be obtained, but they are very nearly correct.

At a short distance above No. 1. there is a compact sandstone, evidently the lowest of the Conemaugh section. This is not the Mahoning Sandstone, since below it are two coal beds and the Johnstown Ore, so that that sandstone is represented along this line by shale. This explains the fact, that its place is always concealed by debris on the Conemaugh. Of the upper Conemaugh sandstone, great blocks are shown on the hillsides, but the stratum is not exposed in place. It is handsomely massive, and has a delicate gray to bluish-gray tint.

The shale overlying the *Upper Freeport coal bed* is dull brown, and gradually becomes sandy toward the top. A variable layer of clay interposes between it and the coal.

The *Upper Freeport coal bed* is mined by the Kirkpatrick heirs, opposite the ford, where it shows:

1. Coal,	2' 2"	} 8' 11"
2. Clay,	1"	
3. Coal,	1' 2"	
4. Clay,	2"	
5. Coal,	4"	

In this bank there are no true clay veins, but the roof clay frequently swells so as to do great injury. One of these swells actually cuts out all the coal. Another, seen near the mouth of the pit, has removed all but one foot of the coal, and breaks up much after the manner of clay veins. The coal is brittle, and is badly broken by binders of pyrites. At Mr. James Snodgrass' mill an opening shows:

1. Coal,	2' 6"	} 5' 1"
2. Clay,	1"	
3. Coal,	5"	
4. Clay,	1"	
5. Coal,	1' 6"	
6. Clay,	2"	
7. Coal,	4"	

The roof is very insecure, and the clay frequently swells, but at no time so seriously as in the Kirkpatrick bank. The coal is sulphurous throughout, and especially so about midway in the top bench. It is very hard and must be blasted, but is so brittle that there is much loss in breaking the blocks after they are shot down. Other openings were seen in this vicinity, none of which differs materially from those already referred to. The bed passes under the creek just above Mr. John Stuyvesant's house, about two-thirds of a mile below the woolen-mill.

The Freeport Limestone was observed only where it rises from the creek, below the ford, and the exposure there is imperfect. The rock has been burned into lime. The *Lower Freeport coal bed* was seen above the ford, where it is exposed in the bank of the stream. It has been mined by stripping in the bed of the stream, and the coal is said to be very good.

The south-eastern out-crop of the *Pittsburg coal bed* enters Loyalhanna township from Salem, with the Saltsburg and New Salem road. Thence it follows a north-north-east course to the Saltsburg and Pittsburg road, where it is deflected almost to the line of Bell township. Returning, it resumes the same course, and crosses into Bell township at about one mile from the Conemaugh river. Half a mile beyond the line, the direction is changed to rudely north-west, which is retained for nearly a mile, when the line curves and becomes the north-western out-crop. From this point the line of out-crop and Shaffer's run, constantly approach until, at the head of the run, the former crosses and, curving on itself, follows a north-east course to the Gartley school-house, on the Saltsburg and Pittsburg road. There again curving on itself, it takes a rudely south-west direction and finally crosses into Salem

township, at barely one-fifth of a mile west from the extreme corner of Loyalhanna, and not more than one-fourth of a mile from the out-crop at the head of Shaffer's run. Aside from this, there are some small areas in Bell township, belonging to Mr. Alcorn, Mr. Beatty, and Mr. Hine, the last in the northern portion of the township and very near the Conemaugh. It is far up the side of the Waynesburg anticlinal. Other small areas possibly occur in the high hills directly west from Shaffer's run, but if they do, they have so slight cover that the coal is, without doubt, worthless.

The structure of the bed in by far the greater part of the large area is fairly shown at the extensive mines of the Saltsburg Coal Company, where the section is:

1. Pittsburg sandstone,	—	
2. Shale,	1' to 10'	
3. Roof division—		
Coal,	1' to 3'	} 1' 6" to 3' 6"
Clay,	2'	
Coal,	4"	
4. Main clay parting,	3' to 1"	} 10'
5. Lower division—		
1. Coal,	2' 2"	} 7' 8"
2. Parting,	2' to 1"	
3. Coal,	3' 2"	
4. Parting,	1' to 1"	
5. Coal,	8"	
6. Coal,	1' 6"	

The main clay parting is at times barely perceptible, while at others it becomes 3 feet thick, the variation being made at the expense of the roof division. The upper coal of the latter contains many streaks of clay, which increase to a thickness of several inches, displacing an equal amount of coal. The general structure of the lower division, it will be noticed, is quite different from that observed elsewhere in this trough. The parting, No. 4, reminds one of the bed as it is in the northern part of the Blairsville trough, but is a new feature in this. The bearing-in bench is wholly wanting, there being no parting in No. 3. The two partings shown in the section are subject to annoying variations; No. 2, at some places in the pit, cuts out all the coal of the overlying bench, and No. 4 sometimes displaces all of the brick and

part of the lower bottom. They consist of compact clay, and the swellings do not appear to be associated with spars or clay veins. The bench, No. 3, is quite sulphurous. In some portions of the mine it shows lenticular nodules of pyrites, 2 to 4 inches thick and several feet long. Thin binders of the same material are common in the top bench. The brick is almost cannel, and the lower bottom is inferior.

The coal is more or less columnar throughout, and careful handling is needed to bring it out in good shape. It contains so much sulphur as to be very injurious to grate bars. In these respects, it is decidedly inferior to coal from this bed further south in this trough; but careful experiments made by the Pennsylvania Railroad Company prove it to be one of the best steam-producing coals in the country, and that company purchases nearly all the coal taken from these mines for use on the engines of passenger trains. Much of the coal is shipped to Jersey City, for consumption on the New Jersey division of that railroad. That this coal is used for the purpose, despite the proportion of sulphur present, is indisputable evidence of its superior value for steam-producing.

On the Pittsburg road, the coal is mined by Mr. Anderson, and, on the road leading thence to Rambaugh's ferry, by Mr. Robinson and Mr. Kunkle. At these openings, as well as at one near Woolford's old mill, on Shaffers run, the section is very similar to that exhibited at the Saltsburg company's works, but the lower parting does not vary to the same extent as the upper, which sometimes becomes a foot thick. The coal has the same character, differing only in that the pyrites seems to be more generally distributed throughout the bed.

Further up Shaffers run, the bed has been opened by Mr. Adair, Mr. Alcorn, and Mr. McKee; and, on the other side toward the Pittsburg road, by Mr. Rugh, Mr. Beatty, and at the Gartley school-house. In these, the partings given in the section are present, but, though varying in thickness, never increase so as to cause much annoyance. The top bench is occasionally broken up by variable slates, and its upper portion for 10 inches is quite inferior in quality. The

"bearing-in" bench is distinct here, and the "brick" is from 6 to 8 inches thick.

No exposures occur above the *Pittsburg bed* and the localities are few, at which the character of the rock immediately overlying the coal can be determined.

Away from the area of upper coals, the surface rocks in Bell township belong to the Lower Barren Series, except along the Conemaugh river and Beaver run, in the vicinity of the Waynesburg anticlinal, so that in the greater part of the township nothing of interest was observed. The details of the region along the Conemaugh will be found in Mr. Platt's report on Armstrong county.

On Beaver run the following section was obtained above Rubright's mill :

1. Coal bed,	3'
2. Concealed,	40'
3. Sandstone,	12'
4. Shale,	10'
5. <i>Upper Freeport coal bed</i> —	
1. Coal,	7"
2. Clay,	3"
3. Coal,	2' 7"
4. Clay,	1"
5. Coal,	4"
6. Clay,	1"
7. Coal,	9"
6. Clay,	12'
7. Freeport limestone,	6'

The coal bed, No. 1, has been opened by Mr. Kuhns along side of the run, opposite Mr. Thompson's house. It yields fairly good coal, but is too thin to be worked with profit. The same bed was seen on Squire Long's property as well as on that belonging to Mr. Hine. Its thickness seems to be quite regular. At no great distance above, there is a massive sandstone, of which huge blocks lie scattered on the hillside opposite Mr. Thompson's residence, but it is not exposed in place. It is evidently the same with that observed on the Loyalhanna, near Mr. James Snodgrass' mill. At about 55 feet above the 3-foot coal bed is another, 18 inches thick, which is exposed on Mr. Hine's farm. The sandstone, No. 3 of the section, is part of the Mahoning, and is flaggy. No vegetable impressions

were found, nor does the rock, so far as exposed, contain any conglomerate layers.

The *Upper Freeport coal bed* is mined by Mr. Long, Mr. Hine, Mr. Trout, and others, and shows decided constancy in thickness and general structure, the several measurements showing hardly any variation. The top coal, and its underlying shale, are not removed, being retained to add security to the roof. Each shows vegetable impressions. The layer, No. 3, is so hard that it must be blasted, but it makes an handsome and by no means brittle coal. Pyrites occurs both in lumps and binders, and is so generally distributed as to render the coal quite inferior.

The Freeport Limestone is said to be 10 feet thick and is burned into lime.

27. WASHINGTON TOWNSHIP, OF WESTMORELAND COUNTY.

This lies west from Bell and Salem townships, being separated from the former by Beaver run and from the latter by a tributary to that stream. At the north it reaches the Conemaugh, but the line along that stream is very short. The Waynesburg (Roaring run) anticlinal enters the township near Reed's mill, on Beaver run, and passes out of it into Franklin, crossing Pucketta creek almost due west from Oakland post office. On the former stream, the axis brings up the lower coals but fails to do so on the latter. The section extends from about 75 feet above the *Pittsburg coal bed* at the south to 70 feet below the *Upper Freeport coal bed* at the north, on the Conemaugh opposite Apollo. In the extreme southern portion of the township, a fragment of the upper coals, belonging to the Lisbon (Irwin) synclinal, reaches over from Franklin; and the Lower Coals are caught in part along Beaver run and the Conemaugh, but elsewhere throughout the township one finds only the rounded hills of the Lower Barren Series, with here and there an insignificant exposure of sandstone or variegated shale.

The area of the upper coals is very irregular and occupies less than one square mile, nearly all of it lying west from the Freeport road. The north line of out-crop passes out

into Franklin township at a little south from Mr. W. Hamilton's house, and crosses the Ridge road, between the townships, nearly three miles from the cross-roads, in New Salem. On the northern out-crop the bed is mined by Mr. Steele and Mr. Montgomery, at whose openings the following measurement was made:

1. Roof division,	Concealed.	
2. Main clay parting,		1'
3. Lower division—		
1. Coal,	3' 11"	} 6' 3½
2. Coal and partings,	5½"	
3. Brick coal,	7"	
4. Lower bottom,	1' 4"	

The coal is handsome, bears handling well, and is brought down by wedging. A persistent streak of pyrites occurs in the brick, and another, not wholly persistent, is found in the breast coal at 11 inches above the bearing-in. The lower bottom is perfectly distinct, but is slaty and sulphurous, so that it is not removed.

At 65 feet above the *Pittsburg coal bed* there is a small coal bed, the *Redstone*, overlying a thin limestone which is wanting at nearly all exposures north from Sewickley creek. The interval between the coals is occupied by sandy shale, which at 12 feet above the *Pittsburg*, contains one foot of black shale, which seems to hold a thin coal bed.

Along the Freeport road, north from the *Pittsburg* out-crop, there are no connected exposures. The road passes through the Lower Barrens, and the prevailing rocks are shales or soft sandstones. Along the township line between Franklin and Washington, the Green or Crinoidal Limestone is shown south from Weister's cross-roads, as well as at several points between that place and Oakland Post Office. At all exposures it shows its characteristic greenish-gray tint and an abundance of fossils.

On Pucketta creek, directly west from Oakland Post Office, the Waynesburg anticlinal barely fails to bring up the *Upper Freeport coal bed*, which there cannot be more than a very few feet below the surface of the creek. The coal bed, which, on Beaver run, is 60 feet above the *Upper*

Freeport, is stripped here in the bottom of a little run entering Pucketta. It is about two feet thick, and yields a coal of very fair quality. The blossom of this bed is exposed on the road following the creek, and is distinct on both sides of the axis.

Along the lower portion of Beaver run the *Upper Freeport coal bed* is available for several miles. A coal bed 3 feet thick occurs at 60 feet above the *Upper Freeport*, and it has been mined to some extent. The lower coal bed is mined at a number of openings, all of which show the same section, as follows :

1. Coal,7"	} 4' 8"
2. Clay,	8"	
3. Coal,	2' 7"	
4. Clay,	1"	
5. Coal,	4"	
6. Clay,	1"	
7. Coal,	9"	

Nos. 1 and 2 are not removed. The coal in the rest of the bed is very hard and contains much pyrites in binders and small lumps. No clay veins or horsebacks have been met with in any of the pits, and the bed shows remarkable constancy in thickness. The *Freeport Limestone* is nearly 10 feet thick, and yields a lime which is good for agricultural purposes.

The geology of the Conemaugh line will be found in Mr. Platt's report on Armstrong county.

28. FRANKLIN TOWNSHIP, OF WESTMORELAND COUNTY.

This lies west from Washington and Salem townships, and adjoins Allegheny county at the west. It is drained by the tributaries to Turtle creek, uniting at the southwest, and by Pucketta creek, which flows along the north and north-east border, separating it from Washington and Burrell townships. The Waynesburg (Roaring run) axis enters on Pucketta creek, almost due west from Oakland Post Office, and crosses the Conemaugh pike at a short distance east from Murrys ville. The Lisbon (Irwin) synclinal crosses the pike very near the school-house, about a mile and a fourth west from the village of New Salem.

The section extends from nearly 400 feet above the *Pittsburg* coal to very near the *Upper Freeport* coal bed. Above the *Pittsburg* there are no satisfactory exposures, and the higher coals are so thin, that they rarely make any blossom along the roads, while the limestones, which further south are so characteristic of the upper group, are here thin and earthy, so that they are rarely exposed. No satisfactory section of the Lower Barren Series could be made out, and all attempts to tie together the numerous fragmentary sections obtained proved wholly unsuccessful, owing to the variable character of the rocks, and the consequent impossibility of making identifications.

A fragmentary out-crop of the *Pittsburg* enters the township at the east from Salem, near the Freeport road, and goes southward to the Conemaugh pike, crossing the south side of Turtle creek, which it follows to behind Judge Riddle's house, where it turns upon itself and goes back to Salem township. The line encloses a narrow space rudely resembling a foot and leg. The toe, along the pike, reaches almost to the bottom of the synclinal. The principal out-crop enters at the north on Mr. J. Hamilton's property, about three miles due north from the school-house, on the pike. Thence to Rameley's Post Office, it lies very nearly parallel with the road leading to that post office, until within a short distance of the pike, where it is bent eastward, and crosses the creek, near Mr. Berlin's house, two-thirds of a mile further up. A small patch, embracing in all about 200 acres, on the farms of Mr. J. P. Kemmerer, Mrs. Steel, and Mrs. Hill, lies west from the road, at two miles from the pike.

On this portion of the out-crop, the coal is mined by Mr. J. P. Kemmerer, Mr. Lauffer, Mr. Elias Berlin, and Mr. J. Kemmerer. Mr. J. P. Kemmerer's opening shows:

Roof division, 4 feet; main clay, 10 inches; lower division, 7 feet; total, 11 feet 10 inches.

The roof is not fairly exposed, but seems to consist mainly of inferior coal. The lower division shows the four benches, 56, 3, 12, and 12 inches thick, with thin partings, rarely exceeding one-fourth of an inch. The coal is of good quality throughout, and evidently very rich in gas. Small

nodules of pyrites occur, scattered throughout the entire upper bench, and a thin binder is quite persistent in the brick. The upper division is rather thicker here than at the other openings. At Mr. Berlin's pit, the lower division is only 6 feet 3 inches thick, and the several benches are 46, 3, 11, and 15 inches.

Eastward along the pike, the coal is seen passing under the creek, near Mr. Berlin's house, and near the school-house it is 57 feet under the stream, as shown in a trial pit dugged for the Westmoreland Coal Company. On Mr. Patterson's property, at the head of a little tributary to Turtle creek, the same company made a boring to the *Pittsburg bed*, of which the following is the record, so far as it is trustworthy :

1. Coal bed,	5"
2. Limestone,	3' 3"
3. Clay,	8"
4. Sandstone,	7'
5. Unknown,	2'
6. Limestone,	25'
7. Shale,	12' 9"
8. Coal,	1' 3"
9. Sandstone and shale,	73'
10. <i>Pittsburg coal bed</i> ,	—

The *Pittsburg coal* is at 160 feet below the surface, and has an absolute altitude 1,000 feet above tide water. No. 1 is exposed on the railroad, in North Huntingdon township, near the Manor shaft, and its blossom is occasionally shown on the hills just north from the Conemaugh pike, in this township. No. 8 is quite persistent, and its blossom is shown on most of the roads within this area. No limestone is seen below it at any exposure within this township. In a hole drilled on Mr. Neudorfer's property, half a mile south from Mr. Berlin's house, on the pike, a 7-inch coal bed was found at 13 feet above the *Pittsburg*.

On the pike the coal again comes up opposite Judge Riddle's house, and at somewhat more than half a mile from the township line, it is mined by Mr. Adam Stiger. The section is :

Roof division, seen, 8 inches ; main clay, 6 inches ; lower division, 6 feet 6 inches ; total, 7 feet 8 inches.

The lower division shows the four benches 54, 3, 13, and 16 inches, with partings varying from one-eighth of an inch to one inch. At all of these openings, the lower bottom is inferior. Mr. Stiger's opening is about one mile west from the out-crop in New Salem, and the difference in altitude is 190 feet, showing a west-north-west dip of about 270 feet per mile. Few openings in the coal are worked in this neighborhood, as in most cases, the coal privilege has been disposed of. East from Mr. Stiger's pit the surface rises rapidly, and the coal is not again seen along the pike within the township.

Returning to the out-crop at the west, one finds it on the south side, diverging from the pike but little for a mile from Mr. Berlin's residence. It is worked along this portion by Mr. Amant, Mr. Rameley and Mr. Kistler, at whose openings the sections resemble those already given. From Mr. Kistler's it turns south-east, and crosses the ridge road at somewhat less than half a mile from the school-house. Describing rather more than a half circle, the line returns almost to the ridge road at Mr. D. Kister's, who has the bed, as follows :

Roof division, 4 feet 6 inches ; main clay, 1 foot 3 inches to 7 inches ; lower division, 6 feet.

The lower division shows its benches 47, 3, and 11 inches, the lower bottom being concealed. In the section, I have given this as 12 inches, making the thickness 6 feet. The roof seems to consist almost wholly of coal, and is well exposed at the pit-mouth. It shows a great number of thin hard clay partings, and is bony throughout. Another opening, belonging to Mr. J. Kister, and showing the same section as the last, was seen just before reaching Lyons run. Here the out-crop crosses into Penn township.

In the extreme northwestern portion of the township, and barely a mile south-east from the axis of the Waynesburg synclinal, is a small patch of the Pittsburg coal bed belonging to Mrs. Laird. The structure of the bed is the same with that observed in the openings in Burrell township.

The great part of Franklin township lies within that portion of the Lower Barren Series, which throughout this

region is without either scientific or economic interest. The Green or Crinoidal limestone was seen on the ridge road on the township line, near Weister's cross-roads, and on the road leading from Murrysville to McLaughlinstown, about four miles north from the Conemaugh pike. Along that pike, from Murrysville east to the out-crop of the *Pittsburg coal bed*, there are no exposures.

Reference was made in Washington township to a small coal bed, about 60 feet above the *Upper Freeport*, which was seen on Pucketta creek where the Waynesburg (Roaring run) anticlinal crosses that stream. The same coal is exposed on the Franklin side, but it does not seem to be worked.

29. PENN TOWNSHIP, OF WESTMORELAND COUNTY.

This lies along the Allegheny county border, and adjoins Franklin, Salem, and Hempfield townships. It is drained by the tributaries to Turtle creek at the west, and by those of Brush creek at the east. The Waynesburg (Roaring run) anticlinal crosses it at the extreme west, and the Saltsburg anticlinal, entering from Hempfield at about a mile south from the line of Salem township, passes along the eastern border and leaves the township almost north from Grapeville station, on the Pennsylvania railroad. The Lisbon (Irwin) synclinal crosses the township in an almost straight line, passing just north from Harrison City. The section extends from about 400 feet above the *Pittsburg coal bed*, to probably an equal distance below it.

The western out-crop of the *Pittsburg coal bed* enters this township at the south, about one mile north-north-east from Larimer's station, on the Pennsylvania railroad, and holds an east of north course for nearly two miles, when it it returns upon itself and crosses the Newtown and Murrysville road within one-fourth of a mile of the township line. In this narrow strip, it is mined by Mr. Kistler and others. The line again turns north, and on the extreme northern point the coal is mined by Mr. J. Rose, at whose pit it shows :

Roof division, 4 feet ; main clay, 1 foot ; lower division, 6 feet ; total, 11 feet.

The roof is not fully exposed, but seems to be about between 4 and 5 feet thick, and to consist almost wholly of coal. The lower division shows the benches 44, 4, 11, and 12 inches. At 60 feet higher, a coal bed 4 inches thick is exposed in the road, the interval being occupied by shaly sandstone and sandy shale. The out-crop here turns south of east owing to the valley of the south fork of Lyon's run, and reaches the stream at about a mile from the last opening. There the coal is mined by Mr. H. Barnhart, and by Messrs. Byerly & McKelvey, at 155 feet below the level of Mr. Rose's pit. The dip in a south-south-east direction, then, is about 170 feet per mile. At Mr. Barnhart's opening the coal shows :

Main clay, 1 foot ; lower division, 6 feet.

The roof division is not exposed at either opening, and the owners do not know its thickness. The lower division shows the benches 45, 4, 11, and 12 inches, with all the partings very thin. In Mr. Barnhart's pit, two clay veins have been found, one 7 to 12, and the other 12 inches wide, which have an almost north-north-east and south-south-west course. They extend from the under clay to the roof, and are said to have been found in the overlying rocks. On each side the coal is curled and twisted, so as to be of very inferior quality, and, for several yards away, the surface of the coal along the planes of cleavage is coated with clay. Similar troubles occur in the other mine. From this point the out-crop follows a very irregular course, and crosses the north fork of Lyon's run, into Franklin township, nearly due east of north from this opening.

The eastern out-crop enters at Penn station on the railroad, having been deflected westward by the valley of Brush creek. From Penn station it follows an almost north-north-east direction to within a short distance of the Harrison City and Hannastown road, where it is deflected half a mile to the east, and crosses that road about two and a half miles north from the railroad, and at an elevation 345 feet higher than at the station. Along this portion of the out-crop, it

is mined near Penn station by the Westmoreland and Penn Gas Coal Companies. As exposed at one of the openings belonging to the Penn company, the section of the bed is as follows :

1. Roof division—				
Coal,	4"	} 1' 3"	} 8' 6"	
Clay,	5"			
Coal,	6"			
2. Main clay parting,		8' to 10"		
3. Lower division—				
Breast coal,	4' 1"	} 6' 6"		
Bearing-in and parting,	3"			
Brick coal,	1'			
Lower bottom coal,	1' 2"			

The structure of the bed in the Foster mine, belonging to the Westmoreland company, is the same. In the works belonging to both of these companies the coal is of exceedingly good quality, and is mined for shipment, to be used almost exclusively in the manufacture of illuminating gas. The coal, for the most part, runs with regularity, but in all the mines there are annoying variations in the roof, and sometimes bad clay veins cause much trouble. In the mines of both companies the main clay parting varies ordinarily from 3 to 15 inches, but frequently it is replaced by a black shale, which is very hard, and forms grievous horsebacks in the roof. As this shale is badly slickensided the horsebacks are a source of much danger, though as yet no serious accidents have happened. In the Penn mine, one of these horsebacks extends along the entry for twenty yards, and is twelve feet wide. A similar one of much greater extent was seen in the Foster mine. Under each the coal of the lower division is curled and twisted for somewhat more than a foot, very much as it is in the vicinity of a clay vein. In the Foster mine, the intruded shale reaches through the roof division into the overlying rock.

In the Penn mine, two clay veins were noted. The second has injured the coal on each side to the distance of eight feet. In the Foster mine, one of great extent has been traced for a distance of nearly 450 yards. In one entry it is not far from 6 feet wide, and extends from the under clay through the roof. Though so wide it does not seem to have done

any injury to the coal. Followed into other entries it is found to split up, but the branches do not equal the original mass in their combined width. While, however, the main vein does no injury to the coal, the smaller branches have twisted it for a distance of several feet on each side. In one of the entries the vein has distinctly faulted the bed. A lateral entry starting off on the vein has exposed the coal on each side, and shows it to be slickensided as handsomely as the roof clay is. This branch has been followed out to its end, and is seen tapering off towards the roof until it finally disappears in the main clay parting.

Just east from Penn station the coal is mined by Mr. H. Kiefer. The hill rises 110 feet above this opening, but there is no exposure except that of a thin shaly coal at 80 feet. The same bed is seen in the road beyond Mr. Loughner's house, on the old Kemmerer property, near which is a deserted opening in the *Pittsburg coal bed*. At one mile south from the Hannastown road, the latter coal is mined by Mr. John Garlow, at whose pit it shows.

Roof division, concealed ; main clay, 1 foot ; lower division, 6 feet 4 inches.

The lower division shows the benches, 46, 3, 12, and 14 inches, with the parting under the bearing-in 2 inches thick. The upper bench is bony for 6 inches under the clay, and contains occasional nodules of pyrites. The lower bottom is decidedly inferior coal.

On the Hannastown road, the coal is well exposed at the out-crop for nearly one-fourth of a mile. At Mr. Moore's opening, the lower division is 6 feet 2 inches thick, and shows the benches 44, 3, 12, and 13 inches, with a 2 inch parting under the bearing-in. The out-crop of the bed here is almost on the strike with Mr. Kiefer's pit, near Penn station, yet its altitude by barometer is almost 200 feet greater, showing a rapid rise in the basin, the distance being barely two miles. The line of out-crop is here deflected westward and, crossing the Boquette road, lies west from it until within half a mile of that village, where it recrosses. Making a sharp turn southward, it crosses the run at Boquette and, thence northward to the township line, lies

west from the road to New Salem. Near the mill at Boquette it is mined by Mr. J. C. Kipple, whose opening shows :

Roof division, imp. exp., 2 feet 6 inches ; main clay, 8 inches ; lower division, 6 feet 6 inches.

The lower division shows the benches 45, 4, 14, and 14 inches. The whole bed is mined, but the lower bottom is poor and the breast coal is bony for 6 inches at the top.

Harrison City is almost on the central line of the trough. No exposures occur in the immediate vicinity of this village except a reddish limestone, which is seen on all sides. This is one of the higher strata, and is probably 250 feet above the *Pittsburg coal bed*. Near Manor church, at the head of a stream flowing past Harrison City, the Westmoreland Coal Company made two borings, of which the records are given below. The first is on Col. Paul Brinker's property, at 800 feet east from the church, and the other is on the same property, but at 3,200 feet west from the church. The records are given in detail, but the details are not trustworthy, as the borings were made with the diamond drill. The material comes up as a fine powder, well saturated with water, so that its character cannot well be determined by mere physical examination. Judging from the extraordinary proportion of limestone appearing in the record, I am inclined to believe that, under that name, the person keeping the record has included nearly all the shale found in boring. By far the greater proportion of the limestones given do not exist.

I.

1. Standpipe,	6' 1"
2. Limestone,	7' 6"
3. Clay,	4' 3"
4. Limestone,	14'
5. Shale,	5' 4"
6. Limestone,	16' 9"
7. Shale,	13' 8"
8. Clay and limestone,	18' 3"
9. Shale,	5' 8"
10. Black shale,	10"
11. Coal bed,	11"
12. Shale,	9' 4"

13. Sandstone,	5' 2"
14. Clay and limestone,	16'
15. Shale,	15' 7"
16. Limestone,	22' 10"
17. Shale,	3' 8"
18. <i>Coal bed</i> ,	4' 9"
19. Shale,	5' 3"
20. Shale, etc.,	4' 6"
21. Limestone and shale,	24' 10"
22. Sandstone,	19' 9"
23. Limestone,	9' 2"
24. Clay,	4'
25. <i>Pittsburg coal bed</i> ,	15' 6"

II.

1. Limestone,	22' 3"
2. Shale and sandstone,	11' 1"
3. Limestone,	12' 6"
4. Shale,	2' 3"
5. <i>Coal bed</i> ,	1' 2"
6. Shale and sandstone,	43' 1"
7. Limestone,	18' 5"
8. Shale,	7' 5"
9. Limestone,	29' 6"
10. Shale and sandstone,	32' 4"
11. <i>Pittsburg coal bed</i> ,	8'

In the first section the *Pittsburg coal bed* is:

Roof division, 6 feet 10 inches; main clay, 10 inches;
lower division, 7 feet 10 inches.

In the second the structure is so curious, that the record must be wrong, for the bed nowhere shows anything like it. The record gives:

Coal, 3 inches; shale, 6 inches; *coal*, 15 inches; *coal* and shale, 25 inches; *coal*, 26 inches.

Along the Pennsylvania railroad, the cuts are numerous within this township, but they do not afford the material for a complete section either above or below the *Pittsburg coal bed*. Just east from Penn station, the *Pittsburg coal* is 140 feet by barometer above the track. In a cut, three-fourths of a mile east from the village, the following section was seen:

1. Flaggy sandstone,	20'
2. Concealed,	20'

3. Variegated shale,	20'
4. Green limestone,	8'
5. Variegated shale,	15'

The sandstone is shown in the hill above the cut, and is quarried. The limestone is greenish gray, and rather more earthy than usual, but weathers in the ordinary manner. It is fairly crowded with fossils. The upper portion consists of *Spirifer planoconvexus*, with a little calcareous clay as cementing material. The next two cuts, east, show only shales, and the last one, that directly west from Grapeville station, exhibits the following section:

1. Sandstone,	5'
2. Shale,	3'
3. Coal bed,	10"
4. Shale,	50'
5. Impure limestone,	6"
6. Variegated shale and nodular limestone,	15'
7. Clay,	6'
8. Yellow sandstone,	5'

The relations of this section cannot be made out with any degree of certainty, but the rocks undoubtedly belong near the base of the Lower Barren Series, and the *Upper Freeport coal bed* must be at no considerable distance below the level of the railroad track.

30. NORTH HUNTINGDON TOWNSHIP, OF WESTMORELAND COUNTY.

This lies along the Allegheny county border, south from Penn and west from Hempfield. The Pennsylvania railroad crosses it and the Youghioghenny railroad, beginning at Irwin station, on the Pennsylvania railroad, runs southward into Sewickley township. The Lisbon (Irwin) synclinal passes across, intersecting the Pennsylvania railroad just west from Manor station, while the Waynesburg (Roaring run) anticlinal, crossing the north-western corner of the township, cuts the railroad midway between Stewart's and Carpenter's stations. The drainage depends chiefly on Brush creek and its tributaries, though in the southern portion of the township the streams flow toward the Youghio-

gheny river. The exposed section reaches from probably the horizon of the *Washington coal bed* to somewhat more than 400 feet below the *Pittsburg coal bed*, and, excepting the extreme north-west corner, the whole township lies within the Lisbon (Irwin) synclinal.

The eastern out-crop of the *Pittsburg coal bed* lies without the limits of North Huntingdon. The western out-crop of that bed, within this basin, enters the township at the north, about half a mile west from the road leading to Larimer station, and follows a south-south-west course for nearly a mile, when it turns eastward, and runs irregularly in that direction to Irwin station, where it crosses Brush creek. Just before reaching the station, the line bends sharply to the north, and runs almost to the line of Penn township, where it returns on itself and follows a southerly course to Irwin. This narrow loop is along Coal Hollow, and renders a considerable area of the coal easily accessible. From Irwin station, on the south side of the creek, the out-crop describes an exceedingly irregular line for nearly three miles, the general direction being slightly north of west. After doubling on itself twice, the line crosses the Greensburg and Pittsburg pike, and passes over the Waynesburg axis. It soon returns to the eastern slope of the anticlinal, and follows a tortuous course to the south side of Long run, where it turns sharply westward, and passes into Allegheny county. At somewhat more than a mile further south, it re-enters the township, is deeply indented by Crawfords run, and finally crosses into Sewickley township, at less than half a mile from the Youghiogheny river. The out-crop south from the Pennsylvania railroad is shown on Mr. Shellenberg's map.

In the vicinity of the Pennsylvania railroad, openings in the *Pittsburg coal bed* are very numerous, but for the most part they belong to the great coal corporations known as the Westmoreland Coal Company and the Penn Gas Coal Company. In Coal Hollow, an opening belonging to the Penn company shows:

1. Sandstone and shale, 9'
2. Roof division—

1. Carb. shale,	4"	}	7' 4"
2. Shale and iron ore,	2'		
3. Coal,	1'		
4. Clay,	1' 8"		
5. Coal,	8"	}	14' 3"
6. Clay,	2"		
7. Coal,	5"		
8. Clay,	2"		
9. Coal,	1' 4"	}	8"
3. Main clay parting,			
4. Lower division,	6' 8"		

No. 1 of the roof division is an inferior black band ore, and No. 2 contains much ore in nodules. The lower division shows the four benches characterizing the bed in this basin. In the vicinity of Larimer, there are some large mines belonging to the Westmoreland company, and at Irwin, the following measurement was made at the works of that company :

1. Sandstone,	2'
2. Shale,	28'
3. Sandstone,	10'
4. Shale,	12'
5. <i>Pittsburg coal bed, roof division—</i>	
Coal,	8"
Clay,	2"
Coal,	1' 8"
Main clay,	1'
Lower division—	
Breast,	8' 9"
Bearing-in,	5"
Brick,	10"
Lower bottom,	1' 6"

These two sections of the coal bed show a remarkable variation in the roof, within a distance of little more than one mile, there being 3 feet 5 inches of coal in the first, and only 1 foot 11 inches in the second. Yet in the extensive mines of the Westmoreland company, at Irwin, the roof division shows but little variation, and the section is almost identically the same both north and south from the railroad. In the lower division, the breast coal, or upper bench, has a persistent parting at 7 inches from the top, which contains a streak of pyrites, from zero to one-third of an inch thick. The coal readily comes apart here, and when the pyrites is thick, it is scaled off in the pit. For

the most part, the rest of this bench has a structure closely resembling that of semi-cannel, but the presence of numerous layers of bright bitumen, from one-eighth to three-fourths of an inch thick, prevents it from being an open-burning coal. The tendency to cake is slight, when it is burned in lumps on a grate fire. Pyrites is present in small quantity, except in the lower bottom, which is worthless, and is not removed from the mine. This coal, as well as that from the mines of the Penn company, is held in high repute and is shipped to all the eastern cities for use in the manufacture of illuminating gas. It is easily mined by wedging, and bears handling well.

At the mouth of one of the entries to this mine, the coal rests almost directly on a coarse, impure limestone, 15 inches thick, under which is a 6-inch coal bed, which extends for but a few yards into the entry, and then disappears. Along the face of the hill it was seen for a short distance only, and then thinned out abruptly. Below it is a limestone, which seems to be very irregular, for at only a little way from this entry its place is occupied by a thinly laminated shale, fully 10 or 12 feet thick. A similar condition is exposed at one place within the mine, where, owing to an irregularity in the dip, a tunnel was necessary to preserve the grade.

One of the most marked features is the wonderful regularity of the lower division in these mines, both in respect of thickness and of general structure. The measurements of the several benches, as given in the section, are applicable throughout the mine, except locally, where a clay vein or a horseback has caused disturbance for a few yards. The roof is extraordinarily regular, the two layers of coal being present at all exposures, and their respective thicknesses show variations not exceeding 2 inches. All this, too, in workings whose entries and laterals are several miles long.

On the face of the hill, between the main and the swamp entry, the coal describes a distinct anticlinal. Mr. Shellenberg, general superintendent of the company's works, states that this fold is clearly defined in the first and second cross-

entries, but disappears before reaching the fourth. The shape, therefore, is that of an elongate bowl, inverted. The fifth cross-entry cuts a similar fold, and pierces it by means of a tunnel. This is almost on the line of strike with that observed at the out-crop, and is so strong, that had it not been positively ascertained that the first swell disappears, and that a swamp intervenes between that and this, one could not hesitate to regard the two swells as the same. At the same time they are evidently the result of one operation, and simply illustrate what occurs on a grander scale in the great anticlinals of this region.

On each side of the fold, there is a swamp in the mine. On the western side, where the north-west rise is resumed, the dip is excessive for a time, necessitating a diagonal direction for the entries. The fact that a swamp occurs on the eastern side, points to the existence of a similar fold beyond the limits of the present workings. Respecting this, nothing can be ascertained.

The troubles encountered in these mines, are the irregularities of dip already referred to, a few clay veins, and a series of extensive sandstone horsebacks.

The clay veins are usually narrow, but some of them continue for long distances. The principal ones seen vary in width from 10 to 16 inches. They divide, subdivide, and afterwards re-unite. As none of them has been traced to the point of disappearance, they may all be regarded as persistent, so far as these workings are concerned. The more important veins reach from the under-clay to the overlying shale, and, in most cases, on entering the main clay are faulted, so as to be thrown into the roof at a distance of from 2 to 4 feet from the place of emergence from the lower division. When a vein divides, the branches have the same vertical extent, and show the same general features with the main stem. Another class of clay veins was seen, which in many respects resemble the ordinary horseback. They come from the top, cut out the roof division, and penetrate only a few inches into the main clay parting. How far they reach into the overlying rocks cannot be determined, but the distance must be considerable, as

the shales are sandy, while the veins are filled with soft clay.

In the vicinity of veins belonging to the former class, the coal is seriously affected ; it loses all structure, becomes bony, is very difficult to mine, and when mined is of little value. The change in quality is sometimes more marked in the vicinity of small veins or "spars" than it is near those of large size. In one instance a streak barely 4 inches wide twists itself irregularly through the bed, and injures the coal to the distance of several yards on each side, while not far off in the same entry, one, a foot thick, has produced much less disturbance. The extent of injury seems to depend to some extent upon the course of the vein, so that one passing directly through the bed is likely to cause less damage than one following a tortuous direction, even though the latter be much narrower than the other. As a rule, the smaller veins appear to be much more twisted than the larger ones. Strings of brilliant coal frequently extend from the bed into the clay of the veins ; and similar strings are found in the main clay parting, which, in nearly every instance, are connected with the lower bench of the roof division.

The most serious disturbance encountered in these works is a series of enormous sandstone horsebacks, which have a rudely east and west direction, and extend from the east edge of the Irwin mines well over into the Larimer mines. In the former, the first of these was found in the old workings east from the present main entry. It is nearly 200 yards long, and disappears before reaching that entry. The second comes in east from the swamp entry, between the third and the fourth cross-entry, and attains a size equal to that of the first. Each of these cuts out all of the coal for a considerable distance, but tapers off toward each extremity. In the Larimer mines two similar horsebacks have been found, which are evidently continuous with those in the Irwin mines, to which they are in all respects similar, except in this, that they have not removed all the coal, the lower bottom bench having been left untouched. The last member of the series shows an additional feature of interest,

for not only has it removed the upper three benches, but it has apparently carried the lower bottom to some distance below the proper level of the coal. In all probability, this sinking had no connection with the formation of the sandstone horseback, but is an irregularity produced during the folding of the strata. There is difficulty in conceiving of any combination of circumstances, whereby erosion could occur under the bed, while an eroding current was removing the upper portion of the coal.

On both sides of these horsebacks, deep swamps occur in the mines, and the coal is changed in character so as to be excessively hard. Diggers are unwilling to work in the rooms adjoining, so that a considerable area of the coal remains untouched, and the width of the horsebacks has not been accurately determined.

Along the out-crop north from the Greensburg pike and west from Larimer station, there are many openings in the coal, but for the most part they are not operated, as the coal-right has been disposed of. About two miles south from the pike an opening was seen belonging to Mr. Ray, which shows :

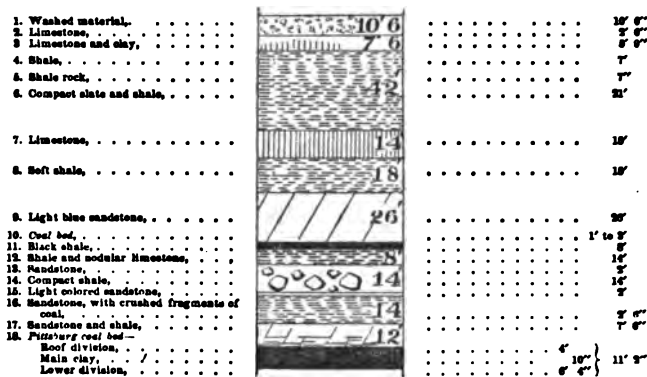
1. Shale,	5"
2. Roof division—	
1. Carbonaceous shale,	5"
2. Ferriferous shale,	6"
3. Coal,	3"
4. Clay,	2"
5. Coal,	1'
6. Clay,	1'
7. Coal,	1' 3"
8. Clay,	4"
9. Coal,	1' 3"
3. Main clay,	1'
4. Lower division,	6' 4"

8' 2" }
13' 6" }

The lower division shows the four benches 47, 3, 10, and 15 inches, with a parting in the upper bench at 3 inches from the base. On Long run, the coal is mined by Mr. Robinson, beyond whose house it passes under the stream. In the south-west corner of the township, near the Yougheny river, the coal is mined extensively, but the bed shows no material difference in structure from that already given.

At a short distance south from Irwin, the coal is mined by the Penn company, by means of a shaft known as the Youghiogheny. For the record of this shaft, I am indebted to Mr. F. H. Oliphant, jr., who had charge of the work at the time the shaft was sunk. The section is shown in Fig. 45 :

Fig. 45.



Youghiogheny Shaft.

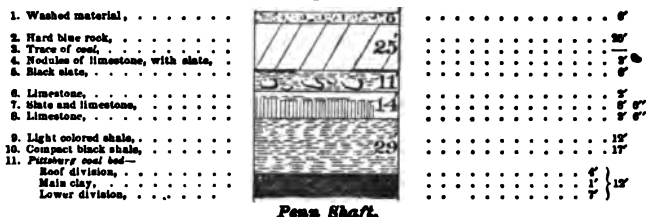
The mouth of this shaft is not far from the horizon of the *Uniontown coal bed*, for that bed is exposed on both sides of the works. The limestone, No. 2, of the section is very clearly the representative of the Uniontown division of the Great Limestone, and the place of the coal is in the washed material forming No. 1 of the section. At the tunnel on the Youghiogheny railroad, not far south from the works, the *Waynesburg coal bed* is exposed with a thickness of somewhat less than three feet, and its coal is worthless. The interval between the *Waynesburg* and *Uniontown beds* was not determined with the accuracy which is desirable, but is not far from 60 feet.

The structure of the lower division in the shaft does not differ from that given as occurring at the other localities in this neighborhood. The coal is of the same quality with that of the Westmoreland company. In this mine, the great sandstone horsebacks of the Westmoreland mines are wanting, but near the bottom of the shaft, the bed is greatly troubled by clay veins, which occur in great number and do serious injury to the coal. At some distance from the

shaft these veins become fewer in number and cause little annoyance. In this mine, there is a tendency to the accumulation of fire-damp, and one explosion has occurred.

Along the Pennsylvania railroad, from Irwin eastward to the Penn shaft, No. 1, only sandstone is exposed, but in the shaft the section shown in Fig. 46 was found. For the record I am indebted to Mr. Oliphant:

Fig. 46.

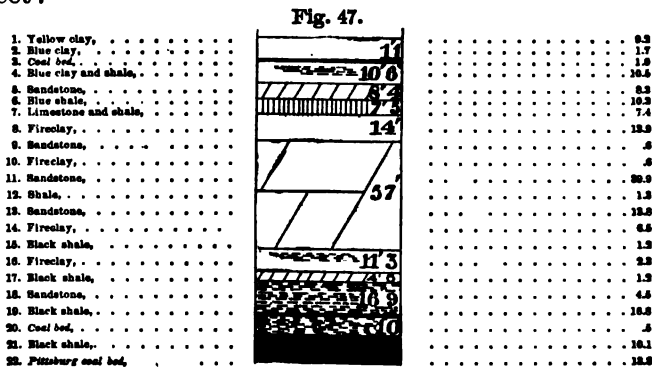


No. 3 of this section is the same with No. 10 of the Youghiogeny shaft, and is the *Redstone coal bed*; the limestone above this coal in each section represents the lower division of the Great Limestone. The limestone, Nos. 6, 7, and 8 of the Penn shaft section, evidently is the same with the nodular limestone found in No. 12 of the Youghiogeny, but the amount of limestone in this section is extraordinary. One can hardly suppose it to be a rock of any degree of purity, and the development is altogether local, for no limestone was seen along the railroad, though the exposures are very good from Irwin to this place. This Redstone Limestone is very irregular in its occurrence throughout the northern portion of this trough, being wholly unrepresented in large areas north from Sewickley creek, and usually appearing only as a nodular rock in shale, as shown in the section of the Youghiogeny shaft. The little *coal bed*, found in the borings made in Penn township, and exposed at several localities in Salem and Washington townships, is here distributed throughout the black shale, No. 10, but in the other shaft only fragments remain scattered through the sandstone, No. 16, of that section.

The *Redstone coal*, though showing only a trace in the Penn shaft, is well exposed in the creek bank near by, and

is worked on Mr. James' property. As has been stated in other portions of this report, such variations are characteristic of this bed. In the Youghioghenny shaft the bed is 3 feet thick on one side and only 10 inches on the other. Here it shows barely a trace in the shaft, while on Mr. James' property it has from one to two feet of coal, and, at a short distance further up the creek, it is 2 feet 6 inches thick. Those who work it here complain of clay veins and horsebacks, which render the coal almost worthless. The bed is roofed by sandstone, gradually passing up into a dull clay, on which rests the lower division of the Great Limestone. The interval seems to be about 40 feet. The limestone consists of several layers, differing from each other in color and composition, but for the most part containing *ostracoids* in abundance. At a short distance further east the *Pittsburg coal bed* is mined by the Shafton Coal Company, whose shaft is 150 feet deep. No record of the section found in this shaft could be obtained. In structure and in the character of the coal, the bed is the same as at the other openings in the vicinity already described. The coal from works in this township is thought to be the best gas coal found within the State, and is shipped east in large quantities.

At about a mile further east is the fine shaft of the Westmoreland Coal Company, which is temporarily idle. The section of this shaft, as furnished by Mr. Shellenburg, is shown in Fig. 47, the measurements being given to tenths of feet :



The little coal bed, No. 3, is exposed in a cut on the railroad, directly under the company's tipple. There it underlies 8 feet of yellowish shale, and shows two benches, 10 and 12 inches, separated by 2 inches of clay. The interval from it to the *Pittsburg coal bed*, 164 feet, is very nearly the same as the interval between the *Uniontown coal* and the *Pittsburg*, in the vicinity of the Youghiogheny shaft, and I am inclined to regard this as representing the *Uniontown*; but there are no exposures in the neighborhood to aid in determining the question. One point, however, is clearly shown. The Uniontown division of the Great Limestone is not present here in the hills above the shaft, nor is it shown in any of the cuts or hollows, so that the identity of this with the *Uniontown coal bed* is more than probable.

A feature of some interest, shown by a comparison of the sections obtained in the shafts and the exposures in the railroad cuts, is the marked and sudden variations of the Great Limestone, which seem to show that it is soon to disappear. In the Youghiogheny shaft, it is 15 feet; in the cut near Shaffon, it is 12 feet; in the Westmoreland shaft, it is barely 7 feet 5 inches; while in a cut, between this shaft and Manor station, it is exposed to the thickness of 28 feet. In the Westmoreland shaft, it is merely a dull, argillaceous, somewhat ferruginous rock.

The *Redstone coal bed* is missing from this shaft, its place being in the interval, No. 11. The little coal bed, No. 20, is the rider which has been referred to as occurring at from 10 to 13 feet above the Pittsburg in Salem, Penn, and Washington townships. It is persistent, either as coal or black shale, throughout this region. In this shaft, the roof division of the *Pittsburg coal bed* has the same structure as at Irwin, but the thickness of the benches is much increased, the layers of coal being 25 and 31 inches, while the clay separating them is 14 inches, giving a total for the roof of 6 feet. The lower division is 6 feet, and has the same section as at Irwin.

The dip, hitherto south-east, is reversed at a short distance east from the Westmoreland Company's shaft, and in the next cut the Great Limestone is exposed.

Along the Greensburg pike, and elsewhere in the south-eastern portion of the township, the covering of debris is so thick, that one is unable to make positive identifications of the fragmentary exposures which are found. South from Shafton, a limestone has been quarried near the tops of the hills, which, from its position, I am inclined to regard as the Lower Washington, but I could not learn whether or not there is any coal immediately below it.

West from Irwin, along the Pennsylvania railroad to the county line, the section, Fig. 48, was obtained, the exposures in the numerous cuts being very fine:

Fig. 48.

1. <i>Pittsburg coal bed</i>,		.....	—
2. Fireclay, . . . . .		.....	1'
3. Limestone, . . . . .		.....	2' to 4'
4. Sandy shale,	25	.....	25'
5. Limestone and clay,		.....	3'
6. Shale,	11	.....	11'
7. Limestone, . . . . .		.....	5'
8. Cl. with some l'n ore	12	.....	12'
9. S'dst'e and s'y shale,	35	.....	35'
10. Limestone, . . . . .		.....	1'
11. Fissile shale,	50	.....	30'
12. Limestone, . . . . .		.....	8"
13. Sandst'e and shale,	17	.....	17'
14. Shale, . . . . .		.....	2'
15. Morgant'n sandst'e,	50	.....	50'
16. Dark clay shale, . . . . .		.....	5' to 9'
17. <i>Barton coal bed</i> ,	5	.....	2" to 10"
18. Clay,	12	.....	12'
19. Limestone, . . . . .		.....	1'
20. Fissile shale,	20	.....	20'
21. Green limestone, . . . . .		.....	4'
22. Clay shale,	15	.....	15'
23. Sandy limestone, . . . . .		.....	1'
24. Sandy shale,	50	.....	30'
25. Sandst'e and shale,	7	.....	7'
26. Dark fissile shale,	55	.....	55'
27. <i>Coaly shale</i>, . . . . .		.....	2'
28. Fissile yellow shale,	15	.....	15'
29. Sandy shale,	35	.....	35'
30. Bl'k sh'l and l'st'e,		.....	4'
31. Clays,	12	.....	12'
32. Sandy shale,	10	.....	10'

West from Irwin.

No lower rocks are exposed along the railroad, under the Waynesburg anticlinal.

The limestone, No. 3, is hard and sandy, and seems to vary much in thickness, having been found 15 feet thick at one locality in the Westmoreland works, at Irwin. In a cut on the Youghiogheny railroad near that borough, it is seen directly under the coal. Nos. 5 and 7 yield a fairly good lime. No. 9 is the representative of the Connellsville Sandstone. It comes up in the first cut west from Irwin, and remains in sight to the second, which gives the section from No. 10 to No. 15, inclusive. No. 13 is a shale, containing a lenticular mass of sandstone. When the sandstone is wanting, the shale contains an irregular limestone from 1 to 4 feet thick.

The Morgantown Sandstone is seen at the end of the second cut, and is traceable along the creek to the first cut west from Larimer. The upper portion is apt to be shaly, but the lower part, as seen in the first and second cuts west from Larimer, is quite compact, and evidently good enough for use in building. Between these cuts a slight synclinal occurs, so that this rock and Nos. 16 to 20, inclusive, are seen in both. The *Barton coal*, in the first cut, is barely 2 inches, but in the second it shows the full thickness given. It is evidently quite sulphurous, for the underlying clay is deeply stained by oxide of iron, which has been washed out from the coal. The limestone below is apt to be nodular. All these strata below the Morgantown Sandstone remain in sight to the tunnel, and there the Green, or Crinoidal Limestone, and the underlying rocks to No. 25 are added. That limestone shows its usual characters, the upper layer being a mass of *Spirifer planoconvexus*, cemented together by calcareous clay, while the lower portion is compact, and weathers into sharp blocks. The other limestone, No. 23, is not fossiliferous.

In the first cut west from Carpenter's station, Nos. 24 and 25 are seen, with No. 26 in addition. The next cut shows Nos. 26 to 30, and in the hollow beyond Nos. 31 and 32 are exposed below the level of the track. Here the Waynesburg (Roaring run) anticlinal crosses the railroad. From

this point to Moss-Side station, the exposed section reaches up to No. 26. In the cut, just east from Stewart's station, No. 27 is distinctly faulted 3 feet.

No. 30 is a sandy limestone, which is streaked with carbonaceous matter, and evidently contains some fossils, but they are few and indistinct. Associated with it is a black shale, which is very rich in fossils. Above the middle is a thin layer, made up almost wholly of crinoidal columns, badly broken, with an occasional plate. Above and below this, molluscan remains abound, and no doubt this stratum would yield a long list of species, were it carefully worked. Fourteen species were obtained during the examination, lasting but a few minutes.

Between Moss-Side and Stewart's, the rocks dip south-east, but just east from the latter station the dip is reversed, and the strata rise in that direction to the crest of the Waynesburg anticlinal. The dip is reversed almost immediately west from Moss-Side. This is a purely local anticlinal, and cannot be traced either north or south from the railroad.

About one mile west from Larimer, are the coke-works of Messrs. Carnegie & Company. This firm uses the slack from the Penn and Westmoreland mines, which they wash before coking. The coke is said to be very good, and scarcely, if at all, inferior to that manufactured in the Connellsville region. One hundred and forty ovens are used.

31. SEWICKLEY TOWNSHIP, OF WESTMORELAND COUNTY.

This lies directly south from North Huntingdon, west from Hempfield, and faces on the Youghiogheny river. It is crossed by the Lisbon (Irwin) synclinal, which enters about three-fourths of a mile west from the north-east corner. In the vicinity of Little Sewickley creek, this axis is shifted eastward fully two miles and a half, so that it crosses the Big Sewickley at a little above midway between Markle's and Bell's mills. In like manner the Waynesburg (Roaring run) anticlinal is thrown eastward, so as to fall within this township, instead of Allegheny county, and crosses the Youghiogheny at the big bend in the river.

about two miles below the mouth of Big Sewickley creek. The shifting of this axis has caused a very awkward irregularity of dip in the north-west corner of the township, which renders mining perplexing. Exposures are imperfect, and the full section of the township was not obtained. It reaches from probably the horizon of the *Washington coal bed*, to about 110 feet below the *Pittsburg coal*.

The eastern out-crop of the *Pittsburg coal bed* enters the township about half a mile south from the village of Madison, and crosses Sewickley creek into South Huntingdon township, at a little more than one mile above Bell's mill. Openings were seen belonging to Mr. Highbarger, Mr. Keifer, and Messrs. Fulton & Pinkerton. At the last the measurement is :

1. Roof division,—		
Clay and coal,	1' 6"	} 9' 11"
2. Main clay partings,	1 3"	
3. Lower division,—		
Breast coal,	4' 2"	} 7' 2"
Bearing-in,	4"	
Brick,	1' 2"	
Lower bottom,	1' 6"	

The roof is imperfectly exposed. The main clay parting is a clay shale, occasionally containing pots of compact clay which cannot be removed without much expense, and are a source of no slight annoyance. The roof is dry and thoroughly strong, so that rooms are driven, 20 feet wide, under 200 feet of cover, in which the only roof supports are slender posts. The coal seems to be very clean and rich in gas. The top of the breast is equally good with the rest, and the lower bottom is often as compact as the breast. Pyrites occurs rarely as lumps, and binders of it are absent. Above the bearing-in, the coal is handsomely irised. No clay veins or horsebacks have been met with in these pits.

The blossom of the *Redstone coal bed* is exposed along the roads in many places, and, near the mine belonging to Messrs. Fulton & Pinkerton, the bed is seen in the hill, 4 feet thick. The exact interval between it and the *Pittsburg* could not be determined owing to the impossibility of getting a direct measurement, but it seems to be not far from

50 feet. The coal is said to be very good, but the bed, as usual, is much troubled by bad clay veins and horsebacks. In the hill, west from this coal pit, the *Sewickley coal* is seen by its blossom, and the lower division of the Great Limestone is partially shown near the hill-top.

Following down the creek, one finds the *Sewickley coal* well exposed at about one-fourth of a mile above Bell's mill, where it is a richly carbonaceous shale, 2 feet 6 inches thick, almost directly underlying the Great Limestone. It rests on its characteristic flaggy sandstone, which is continuous to the out-crop near Fulton & Pinkerton's coal pit. The lower division here comes down to the stream, and the top layers do not go under until nearly two-thirds of a mile below Bell's mill. It is not so exposed at any one place as to afford a direct measurement of the whole mass, but the different measurements obtained show that the thickness of this division cannot be less than 85 feet. Between this and Markle's paper-mill, the exposures are very poor along the creek, but at that locality the Uniontown division is seen by the bridge with the *Uniontown coal* resting on it. This portion of the Great Limestone is 15 feet thick, and 15 feet of sandstone intervene between it and the Lower division, which is under the creek. A well, dugged at the mill, passed through 72 feet of this Lower division without reaching the bottom. Below this, on the creek, the limestone comes up, and the *Pittsburg coal bed* is exposed at about a mile from the mouth of the stream.

On the Youghiogheny river, the *Pittsburg coal bed* makes a double out-crop. That on the Westmoreland side of the river follows the stream quite regularly from the northern limit of this township, to within a short distance of the mouth of Sewickley creek, there being no runs coming down to cut the crop. About half a mile below the mouth of the creek, the line is bent northward and crosses the creek into South Huntingdon, at a mile from the river. Along this line the openings are numerous, and some of the works are very extensive. The bed, however, shows but slight variations, and the measurement taken at the Penn Company's mines, at Sewickley station, is typical of

all the openings examined along the river. As there exposed the bed shows :

1. Roof division—		
Coal,	1'	} 4'
Clay,	1'	
Coal,	2'	
2. Main clay parting,	1'	} 10' 10''
3. Lower division—		
Breast coal,	3' 6''	
Bearing-in,	4''	
Brick coal,	1'	
Lower bottom,	1'	

The roof division shows some variation, there being in one portion of the pit, three layers of coal with the same aggregate thickness as that given in the section. The same variation was observed in some other pits. The breast coal shows some clay binders, but they are not sufficient to do any damage to the coal, which here is quite as good as it is at Penn and Irwin, on the Pennsylvania railroad. At all the openings visited the lower bottom is worthless.

For the most part, the coal on the river out-crop lies regularly and shows few troubles. In the Penn Company's works at Sewickley, a horseback in the roof, extending a distance of 4 yards along the entry, has curled the coal under it down to the bearing-in bench. Narrow clay veins occur here, which pass from the under-clay to the roof and injure the coal on both sides to the distance of nearly 2 yards. In the same works a large "soot vein" was seen.

At a little distance north from the river, the Penn company mines the coal by means of a shaft 70 feet deep. At the time of examination this shaft was not in operation. In it the dip is somewhat irregular and in one "swamp" is reversed for a distance of 300 yards, and the coal falls 50 feet. The structure of the bed is the same as at the Sewickley works, just referred to.

In the eastern portion of the township, northwest from Madison the *Redstone coal bed* is mined by Mr. Bear and Mrs. Mitchell, who have it 3 feet thick and of good quality ; but the bed is troubled by horsebacks and clay veins. Excepting the Lower division of the Great Limestone, no higher

rocks are satisfactorily exposed in the interior of the township. Along the central line of the synclinal, according to the barometer, the *Washington coal bed* should be reached, but there are no exposures to aid in determining the matter.

32. SOUTH HUNTINGDON TOWNSHIP, OF WESTMORELAND COUNTY.

This is the southern township along the line of the Youghiogheny river. The Saltsburg anticlinal enters near the north-east corner and crosses Jacobs creek into Fayette county about three miles from the river. The Lisbon (Irwin) synclinal crosses the township, cutting the West Newton pike at two miles and a third east from that town, and reaching the Youghiogheny river near Port Royal. The section extends from the Lower Washington Limestone to nearly 150 feet below the *Upper Freeport coal bed*.

The eastern out-crop of the *Pittsburg coal bed* enters the township on Sewickley creek about a mile above Bell's mill, and, after running east for a short distance, turns southward so as to cross the road leading to Waltz' mill, at a little way east from the school-house. It there turns westward and follows a zigzag line to the West Newton pike, which it crosses near Mr. A. Robertson's house. From the pike the direction is south-south-west for nearly two miles, but beyond that it is very irregular to Lee's mill. Thence the course is south for about two miles, after which, owing to Jacobs creek and Barnes run it curves to north-north-west and reaches the river at barely three-fourths of a mile above Smith's station.

The first opening seen at the north on Sewickley creek, belongs to Mr. Gott. There the thickness of the bed is 10 feet 7 inches, and the lower division shows the four benches, 50, 4, 14 and 18 inches. Between this and the West Newton pike are openings belonging to Mr. Gott and Mr. Guffey. On the pike, the bed is opened by the Messrs. Robertson and Mr. Pore. Mr. A. Robertson's bank shows:

1. Sand and sandy shale, 10'

2. Roof division—

Coal,	10"	} 8' 8"
Clay,	1'	
Carb. shale,	4"	
Coal,	4"	
Clay,	2"	
Coal,	1'	} 12' 3"

3. Main clay parting, 10"

4. Lower division—

Breast coal,	4' 11"	} 7' 9"
Bearing-in,	4"	
Brick bench,	1'	
Lower bottom,	1' 8"	

The other openings in the vicinity show a closely similar section. In all, the coal is good, and is not disturbed by clay veins. The main clay parting occasionally swells, so as to displace some of the breast or upper bench, and in Mr. W. Robertson's bank one such horseback cuts out nearly 3 feet of coal for a distance of 10 feet along the entry. South from the pike, openings were seen belonging to Mr. Painter, Mr. Shupe, Mr. Rhodes, and others, and a large number were examined near Lee's mill, below which the bed is worked by the Waverley Coal and Coke Company, at Smith's station. Near Lee's mill, the roof division is 2 feet 7 inches thick, showing coal layers, 7, 4, and 8 inches, and clay layers, 10 and 2 inches. The lower division is 7 feet 4 inches, and the benches are 58, 4, 12, and 14 inches, the whole thickness of the bed being 10 feet 5 inches. Underneath the bed, fire clay is seen 5 feet, but there is no evidence that any iron ore is present. The coal is very good, and by far the greater proportion remains as lump after screening. The Waverly Coal Company has erected twenty ovens for coking the slack. The other openings between this and the pike show no material difference.

On the river hill, somewhat more than a mile above Smith's station, the coal shown has a thickness of 11 feet 1 inch, and the benches in the lower division are 60, 8, 4, and 17 inches, a thickening of the bearing-in, apparently at the expense of the brick bench. The coal has the same character as at the openings already referred to. The main clay parting contains numerous streaks of coal, which, in every instance, pass down from the overlying coal.

Along the pike westward from the out-crop, the *Redstone coal bed* is seen at about 50 feet above the *Pittsburg*, and higher up the hill fragments of the Lower division of the Great Limestone are shown. On the first road turning south, the blossom of the *Washington coal bed* is shown, and the *Little Washington coal bed* is present below it, while the Lower Washington Limestone occurs nearer the summit of the road, at but a short distance from the pike. About a mile further west, at a small village, the *Washington coal* is seen at the roadside, where it was once mined. The exposure is clearly imperfect, for only 5 feet of coal and shale can be seen. The limestone above it is dark inside, but weathers to a dirty bluish white, with occasionally a lamellar surface. The bottom layer is ferruginous. The other layers are burned into lime for agricultural purposes, and are used for repairing the pike.

Just west from this, the coal was mined at one time by Mr. Boyd, but the pit was deserted five years ago, and no measurement can be made. The bed is said to be 9 feet thick, and to consist of alternate layers of coal and shale. The coal is slaty throughout, but is regarded as fairly good for family use. The quality, however, must be quite inferior, otherwise the working would not have been abandoned. At Mr. Boyd's house is a sandstone quarry, from which material was obtained for the construction of the pike many years ago. The rock is flaggy, and evidently overlies the coal.

From this point, no exposures were found until the hill overlooking West Newton was reached. On the bench, east from the toll-gate, fragments of the Lower Washington Limestone were seen, but they may have been cast off the road. On the river hill, at 260 feet above the depot at West Newton, there is a thin coal bed, above which, for 65 feet, is a mass of sandstone and sandy shale reaching almost to the toll-gate. This sandstone is soft, and shows strange cross-bedding. It has been quarried on the pike, as well as on the hill opposite the new Presbyterian church. The coal bed under it is most probably the *Waynesburg "a."* Below this everything is concealed by extensive slides.

Along the railroad, the *Pittsburg coal bed* comes up at a

little above the mouth of Sewickley creek, where it is mined by Messrs. White and Heath, and near West Newton, the Youghiogheny Coal Company mine it by means of a shaft. From West Newton to Smith's station, the exposures show only the great series of limestones belonging to the Upper Productive Coals. At Smith's station, the *Redstone coal bed* is at the water's edge.

On the road leading to Port Royal, leaving the pike about two miles from West Newton, the *Washington coal bed* is shown at a short distance from the pike, and at Mr. J. McVey's house, the *Waynesburg coal bed* is exposed, with its limestone cropping out in the run, below the house. The intervals between the coals is 135 feet, and that between the *Waynesburg coal* and its limestone is 25 feet. The lower coal bed seems to be not less than 2 feet 6 inches thick, but it has not been opened, so that no details can be ascertained respecting it. Underlying it is a thin-bedded sandstone, extending quite to the limestone, which is 7 feet thick, and exceedingly pure. The top layer is thin, dark blue, and shaly, but the others are compact. Barely one-third of a mile further south, Mr. McVey has opened the *Washington coal bed*, which proves to be a mass of coal and shale, whose layers show such variations in thickness that an exact section cannot be given. Approximately the section is as follows:

1. Coal,	2'	} 8' 10"
2. Clay,	1"	
3. Coal,	2"	
4. Clay,	1"	
5. Coal,	1'	
6. Clay,	2"	
7. Coal,	2"	
8. Clay,	3"	
9. Coal,	2"	
10. Clay,	1"	
11. Coal,	3"	
12. Clay,	3"	
13. Coal,	2'	
14. Clay,	2"	
15. Coal,	2'	

The top of the bed is not fully exposed, and there may be a foot more than is given in the section. Nos. 1, 13, and

15 are not wholly coal, but are broken up by thin layers of clay, which are more or less persistent. The coal is slaty throughout, and is evidently of very inferior quality. At a little way beyond, the coal is in the road, which descends to a run, crossing it at about a mile and half from the pike. In descending, it exposes the *Waynesburg* "a," at 80 feet, and the *Waynesburg* at 135 feet below the *Washington*. Both of these are thin, and the Limestone, Ia, is seen as a bright yellow rock, at 3 feet above the former. Half a mile further on, the Great Limestone shows itself in the road. Its lower layers are very ferruginous, and on long exposure become honeycombed. At Port Royal, the Fishpot Limestone is seen, and the Great Limestone, Lower division, is shown above it fully 65 feet thick.

On the road leading from Port Royal to Smith's station, the Great Limestone is seen just east from the brick school-house, and under it is the *Sewickley coal bed*, 4 inches thick. At a mile and a half from Smith's station, the Fishpot Limestone is well exposed, with a thickness of about 20 feet. The greater part is a limestone of superior excellence, but the bottom layer is ferruginous and somewhat argillaceous. Above and below it, there is thin-bedded sandstone. The *Redstone coal bed* has been opened on Mr. J. McClellan's property, about one mile from Smith's station, where the section is:

1. Black shale,	8'
2. Clay,	1' to 2'
3. Coal,	2' 9"
4. Clay,	1'
5. Sandy shale,	10'
6. Redstone limestone,	in the run.

The coal is good, but contains much ash. Mining is sadly interfered with by broad clay veins, which replace the coal for several feet. Both the under and upper clay swell, and sometimes the swells occur together, so that the two horsebacks almost meet. The overlying black shale is very rich in carbonaceous matter, and its lower portion, for 2 feet, burns readily, but contains so much ash as to be an inconvenient fuel. This coal bed has been well opened, near Smith's station, at the tipple of the Waverly Coal Company.

There it becomes 4 feet thick, but shows the same defects as at the opening just referred to.

Along the river, the *Redstone* comes down to the railroad track, about one-third of a mile above Smith's station, and goes under the river just below that station. Its limestone is in the river bed at the station, and is exposed at the coal works, showing a thickness of barely 6 feet. It is quite ferruginous, but otherwise seems to be quite clean, and doubtless would be good as a flux. On the road leading north from Lee's mill, the same coal is exposed, but it is not worked. There it is 60 feet above the *Pittsburg*. On this road, at one mile from the West Newton pike, the Waynesburg Limestone was seen. Half a mile further north, Limestone Ia is imperfectly shown, and near the pike the *Washington coal bed* shows a small blossom. It is evidently much thinner here than at the village on the pike at a little distance further west.

East from the out-crop of the *Pittsburg coal bed*, the rocks in the interior of the township belong to the Lower Barren Series, and, as in nearly every other portion of this county, exhibit nothing of interest. Exposures are not rare, and short sections can be obtained at many places. But these consist of characterless sandstones or shales. Two thin coal beds occur near the middle of the series.

On Sewickly creek, the *Upper Freeport coal bed* is reached, and is available for somewhat more than a mile from the eastern line of the township. It has been opened by Mr. Gaffney and Mr. Harold. The section is :

1. Mahoning sandstone,	20'
2. <i>Upper Freeport coal bed</i> ,	5'
3. Clay,	12'
4. Freeport limestone,	1' 6"

The sandstone is evidently not less than 40 feet thick. It is flaggy and contains numerous impressions of stems. The coal is variable in thickness, and shows three benches averaging 38 to 40, 18, and 4 to 6 inches, with two clay partings, 1 to 3 and 1 inch thick. In quality it varies little, being sulphurous and inferior throughout. The limestone is in

two layers, 12 and 6 inches, of which the upper yields a lime good enough for agricultural purposes.

On Jacobs creek, for a mile and a half above its mouth, all the rocks belong to the Lower Barren Series, and consist almost wholly of shales and sandstones. Half a mile above the mill, a thin coal bed is exposed at the mouth of a little run, but it is of no value. At about two miles from the river, the *Upper Freeport coal bed* is mined, and varies in thickness from 3 to 4 feet; its coal is said to be of fair quality and to yield good coke. Several openings were seen along the creek, within a distance of perhaps three miles, but they are all poorly worked, and none of them affords a satisfactory exhibition of the bed. Lower coals belonging to this series are exposed here, but they are thin and comparatively valueless.

Some beds of iron ore occur here, which belong to the Lower Productive Coal Series; some of these have been referred to in another connection, and all of them have been fully described by Mr. Platt in the coke report, so that no further reference to them is necessary in this place.

33. ROSTRAVER TOWNSHIP, OF WESTMORELAND COUNTY.

This is the south-eastern township, and is separated from the rest of the county by the Youghiogheny river. It lies between Allegheny and Fayette counties, and has a long face on the Monongahela river. The Lisbon (Irwin) synclinal enters near Port Royal, and passes through the south-east corner of the township. The Waynesburg (Roaring run) anticlinal passes through the north-west corner. The exposed section extends from the Upper Washington Limestone to the Morgantown Sandstone. The Lower Barren portion of the section is reached along the Monongahela, and is well exposed in the vicinity of Webster.

The *Pittsburg coal bed* is available along the whole Monongahela face, at varying distance from the stream, owing to the extent of erosion. It crosses the Waynesburg axis, and at no point is below the level of the river. On the Youghiogheny, the eastern out-crop of the bed enters from South Huntingdon township, at a short distance above

Smith's station, and runs close by the river to the line of Fayette county. In the north-east corner of the township, this bed is again reached near the border of Allegheny county; but in by far the greater part it is deeply buried under the surface.

On the pike leading from West Newton, the lower division of the Great Limestone is seen before reaching the toll-gate, but above it, on the river hills, everything is concealed. Fragments of it are shown in the lane entering the pike near the toll-gate. At a short distance further on, the *Redstone coal bed* is mined by Mr. J. M. Montgomery, and several old openings are in the immediate vicinity. The bed is quite irregular in thickness, varying from zero to almost 4 feet. On top it shows from 8 to 12 inches of cannel shale, which burns readily when broken into small pieces. As usual, this bed is much disturbed by very bad clay veins, one of which, near the mouth of the pit, cuts out all the coal for about 10 feet along the entry. The roof is a dark shale, but it frequently contains pots of slickensided clay, which develop into grievous horsebacks, cutting out half the bed below. The coal is good looking, and burns to a powdery, somewhat bulky ash. It gives some clinker, but Mr. Montgomery has used it successfully in smithing.

The Redstone Limestone seems to be absent here, and along the road crossing the pike at this point, the interval between the *Redstone* and the *Pittsburg coal bed*, is occupied by sandy shale. Half a mile north from the pike, the *Pittsburg coal bed* comes up from the run, and is opened by Mr. J. McMillan and Mr. Hopkins. The section is well exposed at one locality alongside of the run, as follows :

1. Shale,	35'
2. Roof division—	
Carb. shale,	6"
Coal,	2"
Carb. shale,	4"
Coal,	10"
Clay,	8"
Coal,	4" to 10"
Clay,	0" to 6"
Coal,	1'
3. Main clay parting,	10"
4. Lower division—	
Breast coal,	3' 9"
Bearing-in,	4"
Brick coal,	1'
Lower bottom,	1' 1"

} 4' 4" }
 } 11' 4" }

The overlying shale for about 3 feet is thinly laminated and quite fissile, but above that it contains some flaggy sandstone. The lower bottom bench of the coal is not mined, and the available thickness of the coal, deducting 6 inches for waste, is 4 feet 7 inches.

On this run, south from the pike, the *Redstone coal bed* is exposed for fully one-third of a mile. Over it is a mass of sandy shale and shaly sandstone, the latter becoming flaggy toward the top. The upper portion is known as the flag rock, and yields flags of excellent quality. It is quarried at several localities in this neighborhood, and is of no slight economical importance. There is no evidence that the Fishpot Limestone is present here, and the interval between the *Redstone coal bed* and the Great Limestone is clearly occupied by sandy shale or shaly sandstone. The lower division of the Great Limestone comes down to the run, about a mile and a half from the pike, and the *Sewickley coal bed* is seen, 4 inches thick, at three to four feet below it. This portion of the limestone is fairly exposed to the thickness of 40 feet, and much of it is quite pure enough to yield a good lime. The top layers are especially good, and on the weathered surface they have a light blue color. This rock remains in sight for fully two miles from the pike, going under near the first cross-roads. The middle and upper divisions are shown somewhat further on,

and, on the road to Rostraver Post Office, the *Waynesburg coal* and limestone are exposed.

Returning to the pike, and going west from Mr. Montgomery's coal bank, one finds in the roadside some calcareous shale under the *Redstone coal bed*, which contains some nodules of ferruginous limestone, representing the Redstone Limestone. At 45 feet above the coal there is a carbonaceous shale, one foot thick, and at 35 feet higher is the Great Limestone. The last interval is occupied by shale, containing some flaggy sandstone near the top.

At a little way south from the pike, near the county line, the blossom of the *Waynesburg coal bed* was seen near the Baptist church, at no more than 260 feet above the *Pittsburg coal bed*, the interval being measured up the dip. At about a mile due south from the church, near the residence of Mr. A. Moore, the same coal bed is again exposed, with its limestone at 20 feet below it. The coal is thin, not more than two or three feet, and is not mined in the vicinity. The limestone is eight or ten feet thick, the top layer being blue and having a slaty structure. The other layers are of good quality, and yield a strong lime. The interval between the coal and the limestone is occupied by a flaggy sandstone.

These rocks remain in sight for a short distance along the road leading from Mr. Moore's to Webster, but they soon run out in the hills, and at the Methodist Episcopal church, the *Uniontown coal bed* is shown at a few feet above the Uniontown division of the Great Limestone, which is very ferruginous. Judging from the blossom, the coal is barely 15 inches thick. For nearly a mile from the church there are no exposures, but at half a mile from Webster, along the lower road, the Great Limestone is shown, and at a few rods further on the *Redstone coal bed* has been opened. It is 3 feet 8 inches thick, with 10 inches of cannel shale on top. As usual, the bed is much troubled by clay veins. The coal is fairly good, but seems to be rather slaty. Nearer Webster, the *Pittsburg coal bed* is reached, and is mined.

On the river hills, near Webster, the *Pittsburg* is exten-

sively mined for shipping by Mr. Guffey, Messrs. Phillips & Mettenuzey, and others. The bed shows great similarity at all the openings, and the following section obtained at Mr. Sheplar's bank, half a mile from the river and two miles south from Webster, is characteristic:

1. Shale,	8'		
4. Roof division—			
Carbonaceous shale,	6"	}	6' 1"
Shale,	1'		
Coal,	8"		
Carbonaceous shale,	6"		
Coal,	1'	}	6'
Clay,	8"		
Coal,	10"		
Hard clay,	2"		
Coal,	1' 2"	}	18' 7"
3. Main clay parting,	1' 6"		
4. Lower division—			
Breast coal,	3' 6"	}	6'
Bearing-in,	3"		
Brick coal,	11"		
Lower bottom,	1' 4"		

The clays in the roof, as well as the main parting, are laminated shale at the out-crop, but within the bank they are found to be merely plastic clays. About three-fourths of a mile from this opening, Mr. D. P. Houseman has sunk a shaft on the *Pittsburg*, in order to supply the local demand for fuel. This shaft, which is 6 feet square, is 130 feet deep, and the levels show that the bed has fallen 95 feet from Mr. Sheplar's opening. The roof division here is said to contain nearly three feet of coal, together with thin layers of clay. The main parting varies from one to fifteen inches, and averages about one foot. The lower division shows the four benches, 42, 3, 15, and 18 inches. As the lower bottom is not mined, the available thickness of the bed is less than 5 feet. The *Sewickley bed* does not seem to have been observed here, but the *Redstone* was found at 60 feet above the *Pittsburg*, and 3 feet thick. The shaft struck on one of the clay veins, so that the coal was found on only one side. At one time the *Redstone coal bed* was mined by Mr. Hunter, not far west from the shaft. The

coal obtained at his bank made an excellent fire, but burned away so rapidly that it was not an economical fuel.

At a short distance east from this shaft, the *Uniontown coal bed* was seen resting on its limestone, and at the cross-roads beyond the Lenity school-house, the *Waynesburg coal* and limestone are exposed in the road. The coal is thin and shows only a small blossom, but the limestone is fully 8 feet thick, and of excellent quality. Southward, along the Webster and Perryopolis road, these rocks are seen near Mr. Fisher's house as well as at the next cross-roads. They remain in sight for half a mile north from these cross-roads.

Just north from the Webster and Perryopolis road, and about three miles south-east from Webster, is a high knob rising about 600 feet above the Youghiogheny river at West Newton, and known as Sheplar's Knob. At 50 feet below the summit, there is a thick limestone, which in many respects bears a striking resemblance to the Upper Washington Limestone as seen in Greene county. It weathers bluish white, and yields a most excellent lime. At 100 feet below it is the *Washington coal bed* which is opened, and shows the following section :

1. White and blue clays,	4'	
2. Coal,	6"	} 9' 3"
3. Clay,	8"	
4. Coal,	8"	
5. Clay,	2"	
6. Coal,	2'	
7. Clay,	2"	
8. Coal,	8"	}
9. Clay,	3"	
10. Coal,	4' 2"	
11. Fire clay,	8'	

Nos. 6 and 10 are not wholly coal, but are broken up by several layers of bony coal, which barely shows a laminate structure. Several of these bear distinct impressions of *Sigillaria*. The coal is slaty throughout, but is said to burn well on a grate, provided a sufficiently large quantity of it is got together. It makes a strong fire and is used for burning lime. Twenty-five years ago it was opened at the north end of this hill, on Mr. M. Beezel's property, but the

bank has been deserted for a long time. Mr. Beezel says that the bed showed full seven feet of coal. The Lower Washington Limestone, which is concealed at the Sheplar pit, is exposed here, and is burned into lime for agricultural purposes.

At Mr. Beezel's house, Limestone Ia is in the road, but the *Waynesburg "a" coal bed*, if present, is concealed. In the run below the house, the *Waynesburg coal bed* was once mined by stripping, and was found to be 3 feet thick. On the same run the *Waynesburg Limestone* is imperfectly exposed.

The Perryopolis road crosses the southern prolongation of Sheplar's knob, and exposes the *Washington coal bed*, which makes an enormous blossom. Further on, the *Waynesburg "a"* is shown and, near the first fork in the road, the *Waynesburg* is seen with its limestone. In the high hill just beyond, the *Washington coal bed* should be caught, but it was not observed. From this point to within a short distance of Rostraver Post Office, the *Waynesburg coal bed* is frequently exposed, and on the hill descending to that place, the whole series of limestones belonging to the Upper Productive Coals is well exhibited.

The character of the *Pittsburg coal bed* in the southeastern portion of the township, is shown in the following section, obtained on the Youghiogheny river, just below the county line :

1. Sandy shale,	9'
2. Roof division—	
Carb. shale,	4"
Coal and shale,	1'
Clay,	5"
Coal,	1' 2"
3. Main clay parting,	1'
4. Lower division—	
Breast Coal,	6' 2"
Bearing-in,	6"
Brick coal,	1'
Lower bottom,	1'

} 2' 11"
 }
 } 12' 7"
 } 8' 8"

In the breast there is a parting at 15 inches from the bottom, and the bearing-in is double. The partings are all very thin. The *Redstone coal bed* is shown in the hills at

53 feet higher, with the ferruginous Redstone Limestone at 4 feet below it and 8 feet thick. The lower division of the Great Limestone has a thickness of 55 feet at one locality. The *Sewickley coal bed* was not seen, but just over the line in Fayette county, it is only 3 inches thick, and almost immediately under the Great Limestone.

The rocks of the Lower Barren Series are exposed along the Monongahela river and, in the vicinity of Webster, the Morgantown Sandstone is well shown. The exposures are not always complete, and the series above the Morgantown Sandstone seems to be made up almost wholly of sandstones and shales.

34 AND 35. BURRELL AND ALLEGHENY TOWNSHIPS, OF WESTMORELAND COUNTY.

These townships are in the north-west corner of the county, and lie along the Allegheny river. The Conemaugh flows along the northern side of Allegheny township. The Pinhook anticlinal enters Allegheny near Leechburg, on the Conemaugh, but its course was not satisfactorily made out. The Waynesburg synclinal passes through the eastern portion of Burrell, and crosses Pucketta creek into Allegheny county near the corner of Franklin township. Some small areas of the *Pittsburg coal* occur near the central line of the Waynesburg synclinal, but elsewhere, except in the immediate vicinity of the Allegheny and Conemaugh rivers, the only rocks exposed are those belonging to the Lower Barren Series. Along the rivers the strata of the Lower Productive Coal Series are reached.

In Burrell township, on the road from McLaughlinstown to Pucketta creek, some small areas of the *Pittsburg coal bed* were seen. Many years ago the coal was opened on Mr. Grier's property, directly west from the village, but owing to the thin cover, the coal proved to be inferior, and the pit was abandoned. At about a mile from McLaughlinstown there is a larger patch, on which are openings belonging to Mr. Borlan, Mr. Yetter and Mr. Hunter. The last shows :

1. Roof division, seen—

Coal,	7"	} 11"
Clay,	1"	
Coal,	3"	

2. Main clay parting, 10"

3. Lower division—

Coal,	2' 10"	} 8' 6"
Coal and partings,	3"	
Coal,	10"	
Coal and partings,	1' 2"	
Coal,	2"	
Coal,	1' 6"	} 6' 9"
Coal,	1' 6"	

The roof division is not exposed beyond what is given and its thickness is unknown. In the lower division there are five thin partings, two more than are usual in the Waynesburg basin, and they all seem to be persistent. The subdivision into benches is strange, and none of the ordinary benches can be recognized, except the lower bottom, which here possesses the same characteristics as elsewhere, being slaty and worthless. Another small area is seen alongside the road opposite the school-house and somewhat nearer the creek. An opening here shows a section very similar to the last.

At the mill where the road passing these openings crosses the creek, the exposed rocks are 500 feet below the *Pittsburg coal bed* at the school-house. Here the Waynesburg synclinal crosses the creek into Allegheny county.

At somewhat less than a mile west from these openings already mentioned, a small patch of the *Pittsburg coal* was seen on the Hall property, almost at the bottom of the trough. No opening is worked here now, but, on the road leading up from the creek at Dougherty's mill, there is another area on the Wallace and Crooks farms, which is mined. At the Wallace pit the section, as far as exposed, is:

1. Roof division—			
1. Coal,	4''	} 4' 7''	}
2. Clay, 1' to	8''		
3. Coal,	6''		
4. Clay,	4''		
5. Coal,	10''		
6. Clay, 1' to	2''		
7. Coal,	8''		
2. Main clay parting,	11''	}	} 10' 5''
3. Lower division—			
Breast coal,	3' 1''	} 4' 11''	}
Bearing-in,	4''		
Brick coal,	8''		
Lower bottom,	10''		

The roof division was measured, where a fall in the roof of the pit had taken place, and, in all probability, the full thickness is not given. In the lower division, the top portion of the upper bench is a fine cannel varying in thickness from 4 to 10 inches. It is separated from the rest of the bench by a distinct parting of black slate, which is usually little more than a mere film. The coal from this lower division is of excellent quality throughout. It is noteworthy that the bed shows the ordinary structure here, but is thinner than at the openings on the other road.

In one portion of the main entry of this pit the bearing-in and brick benches have disappeared and, in their place, a drab fire-clay occurs for about 30 feet along the entry. No distortion of the coal was observed until near the ends of this horse, where this layer is found to be part of an extensive clay vein, which at one end joins this clay to the rocks overlying the coal, and at the other joins it to the under clay. On both sides of the spar-portions of the clay, the coal is badly injured, all traces of structure having been lost. In another portion of the pit, a large clay vein passes through the entire bed, and evidently reaches for some distance into the overlying rocks. In one entry it is thrown aside 4 feet in its passage through the main clay parting, from the lower to the roof division. In the main entry, the passage of this vein has caused a serious faulting of the bed. The extent of the fault is 3 feet, but it is local, the downthrow of only a small fragment, for at a few feet further on in the entry, the bottom of the bed is found

in its proper place, as though no faulting had occurred. On each side of the vein for a considerable distance, the coal is tough as limestone, wholly without structure, and excessively difficult to mine. This curling does not shade away into the good coal, but ends abruptly, and the line of separation between the good and bad coal coincides quite closely in direction with the edge of the vein.

Along the Allegheny Valley railroad, the exposures are very imperfect for nearly three miles from Parnassus station, at the mouth of Pucketta creek, but there seems to be sufficient reason for asserting that the rocks above river level for that distance belong to the Lower Barren Series, and that the Mahoning Sandstone does not come to the surface until within a mile of Lockhart station.

The section of the Lower Productive Coal Series, so far as exposed along this railroad, is the following, obtained by Mr. I. C. White, opposite Freeport :

1. Mahoning sandstone,	55'
2. Sandy shale,	1' 6"
3. <i>Upper Freeport coal bed</i> ,	3' 6"
4. Fire clay,	1' 6"
5. Freeport limestone,	3' 6"
6. Sandy shale and flaggy sandstone,	68'
7. Carbonaceous shale,	10'
8. <i>Lower Freeport coal bed</i> ,	1' 6"
9. Fire clay,	5'
10. Freeport sandstone,	45'
11. Coaly shale,	at river.

The Mahoning Sandstone is a massive rock, which usually forms a distinct bluff; and is readily followed from where it first appears, below Lockhart, to Freeport. No. 2 of the section is variable, from 0 to 6 feet thick, so that frequently the sandstone rests directly on the coal.

The *Upper Freeport coal bed* rises from the river bed at a little way below Lockhart station, and, thence to a short distance above Chartiers station, it is almost constantly in sight alongside of the railroad. Above Chartiers, it rises more rapidly, and openings are few from that station to the mouth of the Conemaugh. The relations of this coal to the overlying sandstone are such as to cause excessive variations in its thickness. Above Tarentum for some dis-

tance the coal is nearly 8 feet thick, in two divisions, separated by a layer of fire clay. The upper division consists of alternations of coal and clay, and the structure of the bed throughout reminds one of that seen along the west face of Chestnut hill. Where this thickness prevails, 6 feet of shale separate the coal from the sandstone above.

At a short distance further up the river the sandstone cuts out the upper division, while at half a mile below Chartiers station the lower division is invaded, so that within two-thirds of a mile the bed is 6 feet, 4 feet, 5 feet, 3 feet 6 inches, 4 feet, 0 feet, and 4 feet 6 inches. At Chartiers, the structure is the same as that found on Beaver run, in Washington and Bell townships, of this county; but at the stone-quarry, about a mile further up the river, it is only from 10 inches to 18 inches thick. From this point, exposures of the bed are few, but it seems to vary from 3 to 4 feet, though, as the exposures are not continuous, one may not regard these as the extremes. The coal from the *Upper Freeport* here is similar in quality to that obtained from the same bed on Beaver run.

From 1 to 4 feet below the *Upper Freeport coal bed* is the Freeport Limestone, which is 3 to 5 feet thick, usually somewhat ferruginous, but otherwise quite pure. In the cut, immediately above Chartiers station, it suddenly divides, and three layers are set off from the main bed. The principal bed is not diminished in thickness, and the others thicken as they leave the place of separation. The lower beds disappear within forty yards. At the quarry above the Soda-Works station, the limestone is wanting.

The interval between the Freeport Limestone and the *Lower Freeport coal bed* contains a curious, irregularly-bedded sandstone, which in portions is concretionary. Some of the layers are coarsely conglomerate, and others show carbonized fragments of vegetable matter. This rock is much used by the railroad company for ballasting the road.

The *Lower Freeport coal bed* is very irregular in thickness. It is dugged in a small way at McKain's station, and is about 4 feet thick, in two benches, separated by a thin clay. The coal is good, but very soft.

The same series is exposed along the Conemaugh, and the section is the same with that given. On both rivers the coal is mined to only a small extent, and the country depends largely on the *Pittsburg* coal, carried by the railroads.

CHAPTER XIII.

Allegheny County, east from the Monongahela and Allegheny Rivers.

36. ELIZABETH TOWNSHIP, OF ALLEGHENY COUNTY.

In this, as represented on the map, are included the three townships now known as Forward, Elizabeth, and Lincoln. The boundaries of these could not be satisfactorily ascertained, there being no accessible map of later date than that of 1862, which was used in constructing the map accompanying this report. Elizabeth is the southern township of the county, with the Monongahela river at the west and south-west, and the Youghiogeny river at the east and north-east. It is crossed by the Waynesburg synclinal, and at the north by the overlapping portion of the Pin Hook anticlinal, which in Report K, for 1875, was called the Peters Creek axis. In by far the greater part of the township, the rocks belong to the Upper Productive Coal Series, and the Lower Barrens are exposed only along the rivers, and for short distances up the runs. A glance at the map will show how extensive is the area of the *Pittsburg coal bed*, the lowest member of the Upper Coal Series.

Along the Youghiogeny river, from the county line to opposite Coultersville, the out-crop of the coal is continuous, though occasionally bent toward the interior by the runs, but below Coultersville, the line leaves the river, and no coal is seen near the stream, until one approaches McKeesport. On Howells run, which enters the river about a mile from the county line, there are numerous openings in the *Pittsburg coal bed*. On the main run, those belonging to Mr. Scott, Mr. Price, and Mr. Mays, were examined, which show the following structure:

Roof division,	4' 1"
Coal,	0' 10"
Clay,	1' 2"
Coal,	2' 1"

Main clay parting,	1'
Lower division,	5' 6"
Breast coal,	3' 6"
Bearing-in coal,	2"
Brick coal,	11"
Lower bottom coal,	11"

The carbonaceous shale, usually forming the top layer of the roof division, is not well shown here. The lower coal of the roof seems to be quite regular in thickness, but is apt to be badly broken up by layers of clay, from half an inch to two inches thick. In the "breast coal," a parting is measurably persistent about midway, and is always pyritous. Binders of pyrites occur, and the face of the coal is frequently covered by films of calcite. In Mr. Scott's pit, there is a clay vein, which has a north-east and south-west course, is seven to eight inches wide, and on one side curls the coal to a distance of nearly two feet, while on the other side no injury has been done. In all these pits, the coal is clean and good, and tough enough to bear shipping.

Above the *Pittsburg coal bed*, on this run, only shale and sandstone occupy the interval to the *Redstone coal bed*, a distance of 60 feet. In the lower portion of this interval, there are many thin and somewhat argillaceous layers, containing indistinct impressions of plant-stems, and rarely of leaves. On Pierces fork of Howells run, heading near the Round Hill church, an old opening in the *Redstone coal bed* was seen, which shows the bed about 4 feet thick. The coal is evidently dirty, and contains many thin layers of slate, some of which show impressions of *Calamites*. The roof is a black shale, which passes imperceptibly into the sandy shale above. The interval between the two coal beds was measured 55 feet here, but it is said to average 60 feet in this vicinity. Near this opening in the *Redstone*, there is overlying the *coal* a massive sandstone, fully 50 feet thick, but at a short distance further up the run, near Mr. Finney's house, a thick bed of shale is seen, containing the Fishpot Limestone, while above and below it are sandy shales, holding some flaggy sandstone. The massive sandstone, therefore, is merely local, replacing the rocks properly belonging in this interval.

At Mr. Finney's house, the *Sewickley* coal bed is seen, represented by about one foot of carbonaceous shale, and immediately underlies the Great Limestone. The latter remains in sight to near the Round Hill church, where the Uniontown limestone, or upper division, is seen, 14 feet thick, with the blossom of the *Uniontown coal bed* directly above it. Three-fourths of a mile north from the church, the *Waynesburg coal bed* is exposed, near the school-house, 250 feet above the *Pittsburg*, but the Waynesburg limestone, if present, is concealed.

Below the mouth of Howell's run, to within half a mile of Buena Vista, the coal-crop is in the hill overlooking the river, and, formerly, when by means of slackwater, the Youghiogheny river was an available outlet, there were several extensive coal-works here as well as below Buena Vista, at all of which the coal was mined for shipping; but since the dams were destroyed these works have been abandoned. It is unfortunate that the river is no longer an outlet, for, as matters now stand, all the coal on the west side is shut out from market. Some pits are still open, but they are worked on a small scale to supply local necessities.

On the run, entering the Youghiogheny at Buena Vista, the pits are quite numerous, and the structure is as follows:

Roof division,	4' 10"
Carbonaceous shale,	1'
Coal,	1'
Clay,	0' 10"
Coal,	2'
Main clay parting,	10"
Lower division,	5' 6"
Breast coal,	3' 1"
Bearing-in coal,	3"
Brick coal,	1'
Lower bottom coal,	1' 2"

The coal from these openings is similar in all respects to that obtained on Howell's run. In one of the openings a curious clay vein occurs near the mouth, which faults the coal nearly 10". At the base it is a broad roll of the underclay, but above, it suddenly narrows, and passes almost vertically through the coal, throwing off a branch on each

side as it enters the main clay, and again as it goes through the clay of the roof division. It spreads out for a little way on top of the bed, but does not affect the overlying shale. The *Pittsburg coal* is seen for the last time on this run at the forks, nearly a mile from the river, and, on each fork, the *Redstone coal bed* is exposed by its blossom. It is said to be about 3 feet thick. No openings in it have been made.

Logan's Hollow opens out opposite Elrod's station, on the Pittsburg and Connellsville railroad. At the head of of the eastern fork Mr. Brown mines the *Pittsburg coal*, and at the head of the other fork the same bed is mined by Mr. McNeill. The slackwater in the Monongahela is backed up the Youghiogeny to Elrod's station, so that the stage of water is sufficient for floating coal barges, and Messrs. Brown and O'Neill ship a large amount of coal. The structure of the bed at these mines is the same as that already given. Where the two hollows join, the Green Fossiliferous limestone is well shown, with the *Barton coal* and the Morgantown sandstone above it.

Wiley's run enters the Monongahela at barely half a mile below Elizabeth. On both branches the *Pittsburg coal bed* is mined for shipping by Messrs. Woods, Strader & Co., at one of whose pits the following measurement was made:

Roof division,	4' 10"
Carbonaceous shale,	6"
Shale,	4"
Coal,	10"
Shale,	1' 6"
Coal,	1' 8"
Main clay parting,	10"
Lower division, ?	5' 2"
Breast coal,	2' 9"
Bearing-in coal,	3"
Brick coal,	1'
Lower bottom coal,	1' 2"

Between the coal and the underlying limestone there is one foot of fire clay. In quality and general character the coal does not differ from that in openings already described. It bears shipping well, and has a high reputation. Soot

veins occur, which are from three to five inches wide, and usually soften the coal somewhat for a few inches on each side. In one of the entries belonging to the firm, a clay vein was seen, which has faulted the coal nearly two feet, and at three yards from the main vein a spar from it has been thrust through the bed. The clay swells under the coal so as to lift one side at the fault, and apparently to cut away some of the coal on the other. On one side curling reaches to a distance of three yards.

On the southern fork of this run, the *Redstone coal bed* was opened by Mr. Wyckoff, but the pit has been deserted. The bed seems to be little more than three feet, though it is said to become four. On the main fork of Wiley's run, the *Pittsburg coal bed* is above water level quite to the head of the stream, where it is opened by Messrs. Gumber & Huey, whose check-house is reached by traveling nearly a mile under ground to the river hill. At Mr. Boyd's, on the same run, the roof shows but one layer of coal, 2 feet 6 inches thick. Mr. Weddell's bank is still further down. At all of these the structure is similar to that on the other branch, differing only in the somewhat greater thickness of the "breast coal," which is exceptionally thin in the entry, where the measurement was made. The *Redstone coal bed* is present here, but no openings have been made in it.

On Hayden's run, entering the Monongahela river at Elizabeth, the *Pittsburg* is mined for shipment, and the entrance to the pit is a mile and a half from the river, nearly all of the coal in the intervening space having been removed. At a short distance above Hayden's mill, the *Redstone* coal is mined by Mr. Scott and Mr. Van Kirk, at whose pits the thickness of the bed varies from three to four feet. Much annoyance is caused by great bands of clay which cross the bed and replace the coal for several yards along the entry. Unlike the clay veins seen in other beds, these do not distort the coal or destroy its lamination. The *Redstone*, at these pits, yields a good fuel, with little sulphur, but with nearly twice as much ash as that from the *Pittsburg*. Usually, however, the coal from this bed is rich in sulphur. Above the *Redstone*, to the base of the Great Limestone,

the interval is not far from 50 feet, and the Limestone, not fully exposed, is about 50 feet thick. It contains a large amount of calcareous shale.

On the telegraph road, leading southward from Elizabeth, the *Uniontown coal bed* is seen at nearly one mile south from that borough.

Pangborns run (marked Watsons on the map) enters the Monongahela at somewhat more than a mile above Elizabeth. On McKinneys fork of this, the *Pittsburg coal bed* is mined at several pits, which show the roof 2 feet 9 inches, and the lower division, 5 feet 5 inches. The coal is very sulphurous in and below the "bearing-in," and shows a few binders in the "breast." On the same run the *Redstone* has been opened. It is from three to four feet thick, and shows the same character as on Haydens run. On the main streams there are numerous openings in the *Pittsburg*, which show little variation from the following structure :

Roof division,	4' 10"
Carbonaceous shale,	4"
Shale,	8"
Coal,	8"
Shale and coal,	10"
Coal,	2' 4"
Main clay parting,	1'
Lower division,	5' 5"
Breast coal,	3' 3"
Bearing-in coal,	2"
Brick coal,	1'
Lower bottom coal,	1'

The bottom layer of the roof is very slaty, and is broken up by thin partings of clay, so that it is worthless. In the lower division the coal is clean, pyrites binders are few and very thin. Some insignificant horsebacks have been found, and only one clay vein has been cut. Nearly a mile further up this run, the *Redstone* was once opened by Mr. Hayden, but the opening has long been abandoned. The coal from that bed is said to make a strong fire, but is too sulphurous to be used with comfort.

Kelleys run enters the river three-fourths of a mile above the mouth of Pangborns run. Between the two runs the Great Limestone is fairly well exposed, and the *Uniontown*

coal bed was seen just south from the summit. The *Redstone* appears at the roadside, as one approaches Kelleys run. On this run the *Pittsburg* is mined for shipping, and the roof division is somewhat thicker than at any other locality within the township, being :

Carbonaceous shale,	6"	} 5' 2"
Shale,	4"	
Coal,	1"	
Shale,	4"	
Coal,	8"	
Clay,	10"	
Coal,	2' 5"	

The carbonaceous shale on top is a very fair cannel shale. The benches of the lower division are 40, 3, 14, and 14 inches, giving a total of 5 feet 11 inches, which is greater than at any other measurement made. The underlying fireclay is 3 feet thick. One-third of a mile above the disappearance of the *Pittsburg*, there is an old opening in the *Redstone*, and at two-thirds of a mile further up, the Great Limestone is exposed in the run, which falls over it. South from the run, at this place, is a hill which rises high enough to catch the *Waynesburg* "a" coal bed, but no rock of any sort is exposed on it.

The character of the section below the *Pittsburg coal bed* as exposed along the Monongahela river, within this township, is shown by detailed sections obtained on the opposite side, and published in Report K for 1875, so that repetition is unnecessary here. The interval, reaching to but little below the Green Fossiliferous Limestone, contains nothing of economical interest.

In descending the river hill, opposite Monongahela City, the following imperfect section of the Upper Productive Coals was obtained :

1. Limestone, dark, seen,	2'
2. Concealed interval,	8'
3. Sandstone and sandy shale,	26'
4. Concealed interval,	33'
5. Limestone, buff, seen,	2'
6. Sandstone,	10'
7. Concealed interval,	6'
8. Limestone, seen,	2'

9. Concealed interval,	25'
10. Great limestone,	45'
11. Sandstone,	10'
12. Concealed interval,	55'
13. <i>Redstone coal bed</i> ,	Blossom.
14. Shale and clay,	8'
15. Redstone limestone,	1' 6"
16. Sandstone and sandy shale,	46'
17. <i>Pittsburg coal bed</i> ,	11'

No. 1 is part of the Waynesburg Limestone, and No. 5 belongs to the Uniontown, or upper division of the Great Limestone. The lower division of that mass varies in its several layers, some being quite pure, while others are worthless. The *Redstone coal bed* has not been opened in this vicinity. Along the river, from the great bend up to county line, the *Pittsburg coal bed* lies close to the bluff, and numerous openings have been made in it. In all of these it shows the same structure, varying little from the following, obtained on Becket's run, near the county line:

Roof division,	4' 11"
<i>Coal and shale</i> ,	1' 3"
<i>Coal</i> ,	8"
<i>Shale</i> ,	1'
<i>Coal</i> ,	2'
Main clay parting,	1'
Lower division,	5' 7"
<i>Breast coal</i> ,	3' 5"
<i>Bearing-in coal</i> ,	2"
<i>Brick coal</i> ,	10"
<i>Lower bottom coal</i> ,	1' 2"

The coal is of excellent quality, and is shipped to the cities on the Ohio and Mississippi rivers.

In the narrow tongue, between the Monongahela and Youghiogheny rivers, at the northern portion of the township, there are some detached areas of the *Pittsburg coal bed*, which mark the crest of the anticlinal. The larger area, opposite McKeesport, lies on the north-western slope of the fold. In all of these, openings were examined, but the bed resembles the sections already given, and presents no additional points of interest.

37. VERSAILLES TOWNSHIP, OF ALLEGHENY COUNTY.

This lies north from Elizabeth, and has a long front on the Youghiogheny and Monongahela rivers. Owing to the

influence of the Peters Creek portion of the Pin Hook anticlinal, as well as to extensive erosion by Jacks and Crooked runs and their tributaries, the area of the Upper Productive Coals is very small, and is confined to the high ridge at the north, separating the waters of the runs named from those of Turtle creek, the northern boundary of the township. A small fragment of the great Lisbon (Irwin) area is embraced in the extreme south-east corner, and an isolated patch occurs on the dividing ridge, between Jacks run and Crooked run. In by far the greater part of the township, the surface rocks belong to the Lower Barren Series, of which the section extends only to a short distance below the Green Fossiliferous limestone.

On the Pittsburg and Greensburg pike the out-crop of the *Pittsburg coal bed* crosses the road at barely a mile west from the line of Westmoreland county, and thence to the toll-house, the greater part of the coal area lies on the north side of the pike. It is mined on that side by the Westmoreland Coal Company, at Springhill station, and by Mr. Brown, whose railroad passes under the pike, near the toll-house. West from the toll-house the area is much wider north and south, but much of the coal has been removed by Mr. Brown, who enters from the west, and by Messrs. Stewart, Dickson & Co., who enter from the north. The structure of the bed throughout the whole of this area is very simple, and the extremes of variation are as follows :

Roof division,	4' to 4 6''
Main clay parting,	1' to 1 3''
Lower division,	5' to 5 6''

The fireclay under the coal varies from 1 to 3 feet. In the mines of Stewart, Dickson & Co. the underclay never swells, but at one locality, in Mr. Brown's mines, it is said to cut out 15 inches of coal for a short distance. Horsebacks are very rare and "soot-veins" seldom occur. Clay-veins, however, are common, and vary in width from 3 to 6 inches. They appear to have no definite course and frequently sub-divide. I could not ascertain whether or not the sub-divisions had been found to re-unite. In Messrs. Stewart, Dickson & Co.'s works one vein has been identified

for one hundred yards. "Razor-blades" or wedges of clay from the main parting were seen at many points, but they do not seem to bear any relation to the clay-veins. At these pits the coal is usually twisted on each side of the clay-vein, but always to a greater extent on one side than on the other. In some cases, where the course of the vein is unusually tortuous, the change in the coal is more or less perceptible to a distance of thirty feet on one side, while on the other it may reach barely five or ten feet.

At the mines of Stewart, Dickson & Co., near Turtle creek station on the Pennsylvania railroad, the bed is exceptionally thin, the benches being 36, 3, 8, and 12 inches, respectively, so that the available thickness, deducting the bearing-in bench, is only 3 feet 8 inches. At all the mines within this area the quality of the coal is apt to show sudden variations. In some pits the "breast" contains so many binders of pyrites as to be inferior and very tender, while in others the binders are almost wholly wanting. These binders are apt to be most numerous near the "bearing-in."

On the ridge between Crooked run and Jacks run, openings were seen belonging to Mr. Stewart, Mr. Foster, Mr. Mehaffy, Mr. Mackie, and Mr. Daws. At all, the roof division is concealed, and the lower division varies little from the following:

Breast coal,	3' 6"	} 5' 7"
Bearing-in coal,	3"	
Brick coal,	9"	
Lower bottom coal,	1' 1"	

Within this little area no clay-veins or horsebacks have been found. The coal has been mined for many years and but little remains in the ground.

In the extreme southeast corner of the township, the *Pittsburg* is mined by Messrs. Bigley & Co. at Alpsville and Osceola, and the Westmoreland Coal Company is about to open works at the latter station. In character of coal and general structure the bed is the same as in Sewickley and North Huntingdon townships of Westmoreland county, belonging, as it does, to the Lisbon (Irwin) area.

Few exposures occur above the *Pittsburg coal bed*. The

Redstone is represented by black shale at a few localities along the Greensburg pike, but its limestone is absent, and the interval to the *Pittsburg* is filled with sandstone and sandy shale. No full exposure of the Great Limestone was found, but this mass is imperfectly shown in the high hill west and south-west from the toll-house on the pike. It is clearly much thinner than in Elizabeth township, and contains proportionately more of good material for lime. The surface does not rise high enough elsewhere to reach it.

Along the Pennsylvania railroad the exposed section of the Lower Barren Series reaches to within seventy-five feet of the Black Fossiliferous Limestone, and, so far as it extends, is the same as that obtained along the railroad in North Huntingdon township, of Westmoreland county. Along the Youghiogheny river the exposed section includes little below the Green Fossiliferous Limestone, which is well shown on both sides of Elrod's station. It is rather more compact than it is on the Pennsylvania railroad, but has the same peculiar tint and is equally rich in fossils. The *Barton coal bed* was not observed along the Monongahela, but is seen near Elrod's station, on the Youghiogheny, where it is very thin. The Morgantown Sandstone is persistent wherever its horizon is exposed, but on the Youghiogheny it is usually too flaggy to be of service as building stone, whereas, on the Monongahela, near Port Perry, it is a valuable stone, very durable, and having a gray color with slight tinge of blue.

38. WILKINS TOWNSHIP, OF ALLEGHENY COUNTY.

This is north-west from Versailles, and has a short front on the Monongahela river. The Pin Hook anticlinal enters about a mile below Braddock's fields, and follows a direct course through the township. The Waynesburg synclinal skirts the eastern border. On the higher ridges the *Pittsburg* coal bed is found, occupying a very considerable area, which, owing to the deep erosion of streams, has an excessively irregular outline. This area is continuous with that in Penn township at the north. The section in the

Lower Barrens reaches barely to the Green Fossiliferous Limestone.

The road from Brinton station, on the Pennsylvania railroad, to Wilkinsburg, follows for the most part a high ridge, with a deep valley at the east separating it from the ridge, on which is the Greensburg pike, while at the west it overlooks the Monongahela river. The western out-crop of the *Pittsburg coal* crosses to the west side of the road at barely a mile from Brinton's, and remains on that side until within a mile of Wilkinsburg, where it re-crosses, and thence lies on the eastern side. Openings are numerous, the coal being mined along the western out-crop for shipment, and several tunnels passing through the hill, cross the valley at the east and again reach the coal under the Greensburg pike. A small detached area lies south from Wilkinsburg. Along the Greensburg pike the out-crop is well marked on both sides of the ridge at a short distance below the road, and the area reaches to within less than half a mile of Turtle creek. A third prong lies still further northeast, and is separated from the coal of Patton township, by Thompson's run, the eastern boundary of Wilkins. A small portion of the Penn area enters the extreme northeast corner of this township. The coal is mined largely by the New York and Cleveland Gas Coal Company at their works on Thompsons run.

The bed shows little variation in structure, as appears from the following measurements, one from the eastern and the other from the western part of the township:

Roof division—			
Coal,	8"		Con.
Shale,	10"		10"
Coal,	1'	1'	
Clay,	2"		8"
Coal,	10"		10"
Main clay parting,	8"	1'	1"
Lower division—			
Breast coal,	8'	4"	3' 2"
Bearing-in coal,		5"	4"
Brick coal,		10"	11"
Lower bottom coal,	1'	3"	1' 2"

The coal shows only slight variation in quality; it con-

tains little sulphur, is rich in gas, and is in high repute both for steam and gas making.

The surface seldom rises to any considerable height above the coal, and in most instances it is difficult to ascertain the nature of the rock immediately above the *Pittsburg*. The road exposures show sandy shale or sandstone for 40 feet, above which there is a black shale, representing the *Redstone coal bed*. On the northern pike, about a mile from Wilksburg, a limestone, 8 feet thick and 170 feet above the *Pittsburg coal bed*, is quarried, to be burned at a kiln near by. It yields a very strong but dark lime. No other limestone was seen between this and the *Pittsburg coal bed*, and it certainly bears a very striking resemblance in all respects to the Waynesburg limestone. This is at the hill-top, and only its cover, a flaggy sandstone, is shown above it.

In the Lower Barrens nothing of interest is found. The Connellsville sandstone, at 70' below the *Pittsburg* coal, is persistent, but is rarely good enough for building stone. The Morgantown sandstone is quarried at several localities.

The western portion of the township is quite level, and includes much of an old river channel, reaching from the Monongahela, near Braddock's Fields, to the Allegheny, above Lawrenceville.

39. CITY OF PITTSBURG, ALLEGHENY COUNTY.

This city now includes the three townships, marked Pitt, Peebles, and Collins on the map. For the most part the surface rocks belong to the Lower Barren Series, but some small areas of the upper coal rocks still remain in Peebles and Collins, and one faces the Allegheny river, along the Pennsylvania railroad in the old city, between Lawrenceville station and the Union depot. The Nineveh synclinal crosses the Monongahela river in the vicinity of the Six-Mile Ferry, and the Washington anticlinal, now become very gentle, crosses the same river a little below Birmingham. These are very indistinct northward, and could not be traced by the barometer.

In Peebles township the *Pittsburg* coal bed is caught
25—KK.

along the high ridge, known as Squirrel hill, and occurs in three patches along the central portion of the Nineveh trough. The southern one begins on the river hill just below the mouth of Nine-Mile run, and extends northward for nearly a mile and a half, having an average width of barely half a mile. The next one lies east and north from it, in shape rudely resembles an hour-glass, and has perhaps half the area of the former. The northern one is but little separated from the last, is equally irregular in outline, but is somewhat larger. Mr. Brown's coal-works are just below the mouth of Nine-Mile run, but at the time of examination they were idle. At all the openings examined the roof division is concealed, and the remaining portion of the bed shows the following variations :

Main clay,	1' 6" to 10"
Breast coal,	3' 4" to 3' 1"
Bearing-in coal,	3" to 3"
Brick coal,	1' to 10"
Lower bottom coal,	1' 5" to 1' 2"

On the road leading from the old saw-mill, on Nine-Mile run, the second area is almost divided, and the roof division of the coal is seen on both sides of the road. Mr. Stewart's pit is at the southern and Mr. Phillips' at the northern end, while numerous openings were seen on both sides. In the third area, the chief openings are near the Pittsburg nursery.

A small area was seen on the border between Peebles and Collins townships, at a little way east from East Liberty, and occupies part of Mr. Winebiddle's property and those immediately adjoining. A narrow patch has already been mentioned as existing alongside the Pennsylvania railroad, near the Union depot. From these the greater part of the coal has been removed, and in the others mining is, for the most part, carried on energetically to supply the great local demand, so that, before long, the coal will have been wholly taken out. At all the openings the coal is excellent as fuel. Few clay veins were seen, and no case of serious faulting was observed.

There are no exposures reaching to more than 35 feet above the coal. For the most part, the cover is little more than sufficient to afford a sound roof.

In the Lower Barrens, the exposed section reaches barely 50 feet below the Green Fossiliferous Limestone, and the character of the rocks is shown in the Birmingham section, given in Report K for 1875. The Green Limestone is well exposed at many places along both the Allegheny and the Monongahela, and contains many species of animal remains. The Morgantown Sandstone is usually present, but is seldom good enough to be used as a building stone. It has a tendency to become flaggy, and in some cases even shaly. The Connellsville Sandstone is no better. The *Barton coal bed* was not recognized, and the little coal found under the Green Limestone at Birmingham seems to be quite local, as it is absent from most localities on the opposite side of the river.

40. PENN TOWNSHIP, OF ALLEGHENY COUNTY.

This lies directly north from Wilkins, and fronts on the Allegheny river. It contains a large but exceedingly irregular area of Upper Coal rocks, which is continuous with that in Wilkins, and, like it, is deeply trenched on all sides, so that the whole can be mined without recourse to artificial drainage. It occupies the crests of dividing ridges, and, except at one locality, the cover is not more than 100 feet thick.

In the extreme western portion, the coal approaches quite closely to the river. It is mined by Messrs. Stewart, Dickson & Co. on the river side for shipment, and by Mr. Elk, Mr. Mason, and others, near the Frankstown road, to supply local demand at Wilkinsburg and East Liberty. The extremes of variation observed here are :

Roof division,	3' to 3' 7"
Carbonaceous shale,	6"
Coal,	5" to 7"
Shale,	1' to 7"
Coal,	1' 6"
Main clay parting,	9" to 1' 2"
Lower division,	5' 4" to 5' 11"
Breast,	3' 4" to 3' 7"
Bearing-in,	4"
Brick,	8" to 10"
Lower bottom,	1' to 1' 6"

The coal throughout this portion of the township is thoroughly good. Binders of pyrites occur commonly in the

"brick," and sometimes in the "breast," immediately above the "bearing-in," but they are not sufficient to do material injury to the coal. Clay-veins are by no means rare, sometimes 6 inches wide. The curling of the coal extends much further on one side than on the other, and not seldom is wholly confined to one side of the break. Swells of the main clay parting are not infrequent, but they are of insignificant size.

Near the Reformed church, on the Frankstown road, the northern out-crop almost touches the road, and just below the church are the mines of the New York and Cleveland Gas Coal Company, which is said to control nearly all the coal in the eastern portion of the township, aside from some small reserved sections. At a little distance east from the church, the line of northern out-crop bends northward to beyond the road leading from Sandy Creek to New Texas, but immediately east, on that road, the area is almost divided, a great space having been scooped out by the west fork of Thompsons run. In the region between the two forks of that stream, including also the divide between Thompsons run and Plum creek, the coal is mined by Mr. Hershey, Mr. Conliff and very extensively by the New York and Cleveland Gas Coal Company, while south from the Frankstown road there are numerous country pits, of which those belonging to Mr. Morrow, Mr. Donaldson, and Mr. Johnson, were examined. In all of these the section is the same with that already given; the coal is equally good and finds a ready market.

Above the coal the exposures are insignificant. On the Frankstown road, three-quarters of a mile east or north-east from the Reformed church, a limestone was seen, 5 to 7 feet thick, and 150 feet above the *Pittsburg* coal bed, which yields a strong dark lime. It is very clearly the same with that seen on the northern pike, in Wilkins. A coal blossom was seen about midway between the limestone and the *Pittsburg* coal bed, but the place of the bed could not be determined.

The section of the Lower Barrens in this township is almost accurately the same as that at Pittsburg, with the

addition of nearly 100 feet of shale and sandstone at the base. The Green Limestone is persistent at all exposures. The *Barton coal bed* was not seen.

41. PLUM TOWNSHIP, OF ALLEGHENY COUNTY.

This is the northern township along the east side of the Allegheny river, and is separated from Penn township by Plum creek. For the most part the *Pittsburg* coal is found in detached areas, but in the south-west corner is a large area, which is continuous with that of Wilkins and Penn, and extends into Patton at the south. The Waynesburg synclinal enters very near the south-west corner, and passes out at the extreme north-east corner. A glance at the map will show the distribution of the coal, which is so irregular that no verbal description could make it clear.

The continuous area at the south-west is largely controlled by the New York and Cleveland Gas Coal Company, whose railroad follows Plum creek from the river, and reaches the coal above New Texas. Country pits were seen here, belonging to Mr. Davidson, Mr. Carothers and others. One near the Plum Creek church, at which the roof division is concealed, shows the benches in the lower division, 41, 2, 10, and 13 inches. The roof division is variable at the openings here, but usually shows two benches of coal, 8 to 10 inches and 14 to 20 inches, separated by an irregular layer of clay. The carbonaceous shale on top is rarely absent.

Between the two forks of Plum creek is an irregular area, which stretches eastward along a high ridge toward the line of Westmoreland county. The exact limit of the coal at the east on this line could not be ascertained by means of the barometer, and there may be a small area east from that given on the map, but if such an area exist, it is likely to prove of little value. Between the forks of Plum creek the coal is mined by Mr. Sharp, Mr. Armstrong, and others, and differs in no wise from that further south.

Northward from this for three miles, the country is so cut up by the tributaries of Plum creek, that the coal occurs only in insignificant patches, on each of which is a coal pit

worked for local supply. At the extreme northern corner of the township there is an important area, divided by Armstrongs run, which heads by McMath's school-house. Some outlying patches of this are found in the bluffs overlooking Pucketta creek, below Dougherty's grist-mill. In the southern division of this area, the coal is mined by Mr. Armstrong, Mr. Logan, and Mr. McMath. The northern division fronts on the Allegheny river, and has pits worked by Mr. Stewart and others. At all of these the bed shows little variation, and the following measurement obtained near Pucketta creek is typical for the vicinity :

Roof division,	4' 8"
Coal,	5"
Clay,	10"
Coal,	6"
Clay,	5"
Coal,	10"
Clay,	8"
Coal,	1'
Main clay parting,	1'
Lower division,	5'
Breast coal,	8' 2"
Bearing-in coal,	8"
Brick coal,	8"
Lower bottom coal,	11"

The coal is of good quality, and seems to be not inferior to that obtained in the southern portion of the township.

Except on the line between this and Patton township, the cover, though ample to secure good roof and sound coal, is too thin to reach any of the higher well-marked strata of the group. At the locality referred to, some hills rise nearly 200 feet above the *Pittsburg*, but they show nothing aside from sandstone and shale, except a limestone, 8 to 10 feet thick, at 70 feet above the coal. No blossom of coal is associated with this limestone.

On Pucketta creek the section in the Lower Barrens extends, at Dougherty's mill, to 350 feet below the *Pittsburg* coal bed, and at the mouth of the creek it reaches very nearly to the top of the Lower Productive Coal Series. Above the Green Fossiliferous Limestone the blossoms of two coals were seen, but the thickness of the beds could not be ascertained.

42. PATTON TOWNSHIP, OF ALLEGHENY COUNTY.

This is south from Plum and north from Versailles. By far the greater part of the township shows only rocks, belonging to the Lower Barrens, and the area of the *Pittsburg* coal bed is confined to the western third. In the north-west the continuous area, stretching round from Wilkins, through Penn and Plum, extends into Patton, and reaches to the northern pike. There it is separated by little more than 150 yards from a compact mass, which extends southward from the pike to within a mile of Turtle creek. A small outlier occurs in the center of the township, on the dividing ridge between Dirty Camp and McGuires runs.

In the northern portion the coal is mined by many persons for local use. In the southern area, the New York and Cleveland Gas Coal Company mine extensively for shipment, and near Monroeville there are several pits. At all of these the coal shows the same character as in the other townships. It is easily accessible, and the whole of it can be removed without recourse to artificial drainage.

The section in the Lower Barrens within this township is the same with that obtained in North Huntingdon township, of Westmoreland county, and is well exposed along the Pennsylvania railroad.

EXPLANATION OF THE ABBREVIATIONS USED IN THE INDEX.

B. T.	Bullskin township, Fayette Co.
B. T.	Brownsville township, Fayette Co.
B. T. w.	Bell township, Westmoreland Co.
Bur. and All.	T. w. Burrell and Allegheny townships, West'd Co.
C. T.	Connellsville township, Fayette county.
Conn. SS.	Connellsville Sandstone.
D. Lower,	Freeport Coal bed.
D. T.	Dunbar township, Fayette Co.
D. T. w.	Derry township, Washington Co.
E.	Upper Freeport Coal Bed.
E. T. a.	Elizabeth township, Allegheny Co.
E. H. T. w.	East Huntingdon township, Washington Co.
F. L.	Ferriferous Limestone.
F. T.	Franklin township, Fayette Co.
F. T. w.	Franklin township, Washington Co.
G. L.	Great Limestone.
G. T.	Georges township, Fayette Co.
G. T.	German township, Fayette Co.
H. T. w.	Hempfield township, Washington Co.
J. T.	Jefferson township, Fayette Co.
Kitt. C. B.	Kittanning Coal bed.
L. B. M.	Lower Barren Measures.
L. P. C. M.	Lower Productive Coal Measures.
L. T.	Luzerne township, Fayette Co.
L. T. w.	Loyalhanna township, Washington Co.
Mah. SS.	Mahoning Sandstone.
Morg. SS.	Morgantown Sandstone.
M. T.	Manellian township, Fayette Co.
M. T. P. T. w	Mount Pleasant township, Washington Co.
N. T.	Nicholson township, Fayette Co.
N. U. T.	North Union township, Fayette Co.
N. H. T. w.	North Huntingdon township, Washington Co.
P. C. B.	Pittsburg Coal Bed.
P. SS.	Pittsburg Sandstone.
P. T.	Perry township, Fayette county.
P. T. a.	Penn township, Allegheny Co.
Pl. T. a.	Plum township, Allegheny Co.
Pat. T. a.	Patton township, Allegheny Co.
R. C. B.	Redstone Coal Bed.
R. L.	Redstone Limestone.
R. T.	Redstone township, Fayette Co.
R. T. w.	Rostraver township, Washington Co.
S. C. B.	Sewickley Coal Bed.
S. L.	Sewickley Limestone.
S. T.	Springhill township, Fayette Co.
S. U. T.	South Union township, Fayette Co.
S. T. w.	Salem township, Washington Co.
S. H. T. w.	South Huntingdon township, Washington Co.
Sew. T. w.	Sewickley township, Washington Co.
T. T.	Tyrone township, Fayette county.
U. B. M.	Upper Barren Measures.
U. P. C. M.	Upper Productive Coal Measures.
U. C. B.	Uniontown Coal Bed.
U. L.	Uniontown Limestone.
U. T. w.	Unity township, Washington Co.
V. T. a.	Versailles township, Allegheny Co.
W. T.	Washington township, Fayette Co.
W. T. w.	Washington township, Washington Co.
W. T. a.	Wilkins township, Allegheny Co.
Wash. C. B.	Washington Coal Bed.
Wash. L.	Washington Limestone.
X; XI; XII,	Pocono; Mauch Chunk; Pottsville—Formations.

INDEX TO KK.

Fayette, Westmoreland, and part of Allegheny counties, Pennsylvania.

PART I.—Names of Persons and Places.

	Page.		Page.
Adair's opening,	323	Beeson's (W.) residence, . . .	50,179
Adamsburg,	300	Beezel's (M.) property, . . .	365,366
Alcorn's land; opening,	322	Bell township, Westmoreland Co.	
Allegheny county; mountain, 373,62		(B. T. w.),	316
Allegheny Valley Railroad, . . 7,370		Bell's mills,	21,350
Allegheny township, Westmore-		Bennett's opening,	283
land county,	367	Berlin's house and pit, . . .	328,329
Allen (I.),	239	Bethany,	266
Alpsville,	382	Bierer's (Mrs.) opening, . . .	300
Amant mine,	330	Big Sewickley creek,	16,78
Anderson, (J. D.); opening, . . 57,		Big Bottom mines,	188,189
	269,323; 287	Big Bend,	286
Andrews (Prof. E. B.),	102,258	Bigley & Co.,	382
Ansted (Professor),	89	Bird (J. L.),	236
Apollo,	325	Birmingham,	385,387
Armstrong (J.); mine,	230; 389	Black creek,	150
Back (D.),	310	Blairsville anticlinal,	5,13
Backer's opening,	312	Blairsville synclinal,	19,21
Baer (Mr.),	295	Boldens run,	214
Bailey's (W. H.) property, . . 154,155		Bolivar,	289
Bairdstown,	284	Bolivar anticlinal,	12
Baptist church,	363	Booth's creek,	122
Barrens,	6	Boquette village; road, . . .	334
Barnhart (H.); mill; mine, 256; 299; 332		Bort's mine,	315
Barkilon (Mr.),	218	Borlan's opening,	377
Baughman's (Mrs.) property, . . 302		Boyd's house; old mine, . . .	356; 377
Beal (L.),	57,219	Boyer's (J.) opening,	257
Bear (Mr.); mine,	297; 353	Braden (Mr.),	282
Beareer run,	313	Braddock's Fields,	17,385
Beatty's station, P. R. R., . 50,269,275		Braddock's station, P. R. R., . 179,180	
Beatty's (Mr.) land; opening, . 164,		Braely's old saw-mill,	14,268
	165,322; 323	Braithwaite's opening,	229
Beattie (Mr.),	113,120	Brasher's (R. P.) bank,	229
Beaver run,	71,324,371	Breakneck creek,	197
Becket's run,	330	Breniser (Mr.),	283
Beechey's opening; bank, . . . 44; 53		Brewer's mine,	315
Beeson (J. C.); land,	159; 164	Briery mountain,	10

	Page.		Page.
Brinton station, P. R. R.,	384	Coketon; Coal and Coke Co., . 57; 283	
Brisbin's (J.) bank, (W.)	302,304	Cold Spring furnace,	124
Brinker's (Col. Paul) property,	335	Colley's (G.) house,	26,225,228
Broadford,	115,198	Collier's (D.) residence,	146
Bronthaven's opening,	315	Conemaugh river (Kiskiminetas), 2,	
Brown's mines,	315,376,381,386		5,11,16
Brownfield (Col. Ewing),	159	Conemaugh Gap,	105
Brownsville,	8,28,29	Congruity,	295
Brownsville township, Fayette		Conliff mine,	388
county (B. T.),	232	Connellsville township, Fayette	
Brown's run; section,	49,242,243	county, (C. T.),	12,190
Brooks' bank,	135	Connellsville Coal and Coke-works, 180	
Brush creek,	332	Cook; Cook's mills,	215,216,227; 312
Brush run,	256	Coolspring furnace,	167
Brush ridge,	1,13	Core's (J. R. & J. H.) bank,	253
Buckhannon river,	85	Coultersville,	373
Buena Vista,	375	County poor-house,	153
Bullskin township, Fayette coun-		Cove run; house,	70,77,119,172; 254
ty (B. T.),	12,124,194	Crabtree run,	311
Burchinal's cross-roads,	135,136	Crabapple creek,	203
Burton (Mr.),	214	Crab Lick run,	153
Burkholder (Mr.),	281	Craft (Mr.),	230
Burrel township, Westmoreland		Crawford's run,	338
county (B. T. w.),	367	Crooked run,	381
Bute's run,	217	Crow (Mr.); ferry; mill,	119;
Butler (Mr.),	207		136; 15,133,251
Byerly and McKelvey,	332	Crow's (Judge) farm,	112,249,251;
Caldwell's opening,	146	Crook's farm,	368
Campbell (L.); opening,	247;257	Crozier's run,	249
Carnegie & Co., coke-works,	350	Cumberland county, Pa.,	53
Carother's pit,	389	Cunningham & Co.,	235
Carpenter's station,	337,349	Davis (Rev. J.),	284
Carr's tunnel, P. R. R.,	14,268,276	Davidson's pit,	389
Cat's run,	45,241,255	Daw's opening,	382
Caufield's (R. R.) pit,	55	Dawson (Mr.),	145
Chambers' (George) mine,	57,272,273	Dawson station,	197,198,199
Chandler, (Professor),	119,122	Dearth (Mr. C.),	221,247
Charlotte Furnace Co.,	124,195,259	Decker's creek, W. Va.,	15,92,122,124
Chartiers station,	370,371	Deffenbaugh's (Mr.) bank,	145
Cheat river,	2,13,15,124,133	Denholm's opening,	312
Chestnut ridge,	13, 62	Derry township, Westmoreland	
Chestnut hollow,	173	county (D. T. w.),	5,12,278
Christian chapel,	28,225	Detar's (Mr.) opening,	300
Chronshore's (Mr.) opening,	302	Dickie's opening,	312
Clarksburg,	117	Dickson (Steward &),	381,387
Coal hollow,	338	Dirty Camp run,	391
Coal Lick run,	152	Donaldson's pit,	388
Cochran (J.),	198	Donnelly (J.); (W.) bank,	284;285
Cochran & Klester,	197	Dougherty (J.); mill,	269;368,390
Cochran's old salt-works,	308	Downer's run,	209
Coffman's opening,	246	Drague run; hollow,	138;142

	Page.		Page.
Dunbar Company's property, . . .	88, 49	Frost; & Son; station, 115; 176; 175, 178	
Dunbar creek,	8, 11, 77, 176, 384	Fulton's (Col.) opening,	310
Dunbar Furnace Co.; mines, . . .	165, 179; 127	Fulton & Pinkerton's opening, . . .	60, 351, 352
Dunbar station,	178, 184	Fuller (Dr.),	113, 155, 156
Dunbar township, Fayette county, (D. T.),	124, 176	Gaddis (Mr.),	151, 162
Dunbar's camp,	176	Gaffney's opening,	359
Duncan & Bro., shaft,	259, 260	Gallagher's (W. F.) opening, . . .	272
Dunlap's creek; saw-mill,	8, 21, 26, 220, 225; 279	Gardwood (Mr.),	229, 230
East Huntingdon township (E. H. w.),	4, 265	Garwood (George),	240
East Liberty,	177, 214, 217, 387	Gartley school-house,	321, 323
Elder's ridge; Mrs. Elder, . . .	34, 36; 287	Garlow's (John) mine,	334
Elizabeth township, Allegheny county (E. T. a.),	372	George's creek; station,	8, 15, 133, 151; 275
Elk (Mr.),	387	George's township (G. T.), 13, 137, 143	
Elliott (Robert),	212	German township (G. T.),	241
Elrod's station, P. & C. R. R., 376, 383		Gibson (Mr.),	241
Elwell (Mr.),	206	Gilmore's opening,	245
Enterprise Coke-Works,	267	Gist's run,	184, 185
Erhart (M. E.) property,	302	Glass sand,	193
Evans (Col. James); station, . .	164, 167	Goodling opening,	300
Ewing (Boyd & Co.); (A. D.); pits,	169; 119, 171; 172	Gore's house,	247
Fairchance furnace,	121, 142, 149, 150, 161, 252	Gott opening,	354
Fairmount,	117	Graff's (W.) house,	274
Fayette city; county,	208; 133	Graham mine,	53
Ferguson's station,	179, 184, 185	Grapeville; station; ridge, . . .	293, 306; 15; 16
Finney's house,	374	Grassey run,	3, 133, 137
Fisher's (Mr.) house,	365	Great Kanawha river,	85, 87
Flatlands,	15	Greensburg coal company, 58, 297, 298	
Flattown,	145	Greensburg pike,	15
Flatwood's P. O.,	213	Greenfield,	213
Fontaine (Prof.),	98, 94, 102, 104, 108	Gribble (Mr.),	231
Foster's (Mr.) bank,	163, 164, 382	Grier's property,	367
Foster mine, Westmoreland Coal Company,	833	Grove church,	145
Fouch (S. A.),	145	Guffey (Mr.); opening,	354; 364
Foutz (Mr.),	286	Gumber & Huey,	377
Franklin township, Fayette county,	213	Hackney (Mr.),	220
Franklin township, Westmoreland county (F. T. w.),	213	Haines ore,	121
Franktown road,	388	Hair's bank,	177
Frasher (Mr.),	217	Hall property,	368
Frederick,	237	Hamilton, (W.); (J.),	226; 328
Fred's run,	254	Hamm's mill,	273
Freeman (J.),	264, 265	Hammer's pit,	298
		Hanan's (Mr.) property,	172
		Hane's opening,	306
		Haney (S.),	248
		Hannastown,	332
		Harden (Esau),	150
		Harold's opening,	272, 359
		Harrison city; road,	331 335; 295

	Page.		Page.
Harvey's five points, 15,297,311,316		James' property,	346
Haydentown, 150,151		Jeffers (Mr.),	221
Hayden's house; old opening, 172; 378		Jefferson township, Fayette coun-	
Hayden's mill; run, 377		ty (J. T.),	209
Hayti, 152		Jenning's property; run, 295; 22,161	
Hazen's (Mr.) bank, 214		Job (Hugus &),	313
Heath, (White &), 357		Job's hollow,	124
Heisterburg, 237		Johnson (Col.); saw-mill, 277,278; 248	
Hempfield township, Westmore-		Johnston's pit,	388
land county, (H. T. w.), . . . 4,293		Johnstown ores,	119
Henderson's coke-works, . . . 180,183		Jones' (H.), residence; mine, 314; 375	
Henderson's hill; land; siding, 177;		Jones bank (old),	138
182; 183		Jude's hill,	124,168
Hershey mine, 388		Karn's (Mr.),	269
Hertig (Mr.), 136		Kearney station, P. R. R., . . . 268	
Hess, Cowell, Vell & Piersell, . . 223		Keeler station,	199
Hibb's (Mr.), 151,225,232		Kehoe (Mr.),	271
Hickle (J. T.), 187,198		Keim mine,	53
Higginbotham, (Mr.), 248		Keifer opening,	351
Highbarger opening, 351		Kelly's run,	379
Hill's bank, 177,		Kemmerer's (J. P.), farm, . . 328,334	
179,181,182,223,307,308		Kendall's (Capt.) coal bank, 60,111,244	
Hill's (Mrs.) farm, 328		Kepple's run,	311
Hine's (Mr.) land; mine, 322,324; 325		Keubler (Mr.),	269
Hinkenlooper, (Mr.), 312		Keystone Coal Company, . . 40,42,53	
Hoggsett, Bell & Co., 181		Kiefer (H.), mine,	334
Hoover (T. A.); opening, . . 242; 312		Kiester's mill,	198
Hopkins mine, 361		Kimbley's house; opening, . . . 301	
Hopwood (Mrs.); pit, . . 152,164; 156		Kingsworth (Mr.),	272
Horner (Mr.); opening, . . . 58; 312		Kirkpatrick heirs; bank, . . . 320; 321	
Hostettler (Mr.), 246		Kister (D.), coal bed;	330
Houseman (D. P.), opening, . . 364		Kister's (J.) mine,	330
Howell's run, 373,375		Kistler mine,	330,331
Huckleberry ridge, 1		Klingensmith (Mr.),	314
Huey, (Gumber &), 377		Knight (Lewis),	240
Hugus & Job, 313		Krepps (Mr.),	232,233
Hughes' property; opening, . 297; 300		Kuhn's opening, . . . 257,297,299,324	
Hunter (J. J.); 256		Kunkle (M.),	60,323
Hunter's mine, 61; 364,367		Kyle (J. T.),	145
Hursh, Stoner & Co., 267		Laird's (Mrs.) coal bed,	330
Huston's station, 22		Lancaster (Mr.),	229
Hutchinson's mill, boring, . . . 156;		Larimer station; mines, . . 339,349; 342	
108,157,159		Latrobe; Morgans & Co., 57,	
Ice's ferry road, . . 102,142,137,148,172		268,270; 270	
Irishtown hill, 188		Laurelville,	98,127
Irwin station; mines, 24,39,51,338; 342		Laurel station; ridge; hill, 11,	
Iseman's (J.) opening, 302		151; 5,11,62; 201	
Jack's run, 5,15,293,307,381		Lauffer mine,	328
Jackson mines, 117,199		Layton station, . . . 69,78,197,206,213	
Jacob's creek, 4,11,13,		Leechburg,	17,367
15,16,47,92,99,122,127,194,249,360		Lee's mill,	355

	Page.		Page.
Leighty (Mr.),	267	Masontown,	44, 241
Lemmon (J. L.),	256	Mathew's opening,	300
Lemont Furnace Company,	82 ; 50, 113, 121, 165, 169, 173	Mays (T. B.); opening,	261, 263, 264; 373
Lemont mines,	104	McAllister ridge,	10
Lenity school-house,	365	McCreath (A. S.), 27, 55, 60, 61, 89, 112	
Lesley (Prof. J. P.),	12, 13, 18, 82, 83, 94, 251	McCreath (D.),	44, 60, 114, 127
Lesquereux (Professor Leo),	105	McClavy (Mr.),	181, 187
Lewisburg (W. Virginia),	102	McClellan's (J.), property,	358
Lick Hollow,	158, 159	McClellandtown; road,	218; 153
Ligonier valley,	5, 18, 30	McCormick heirs,	60, 217
Ligonier and Latrobe Railroad,	290	McCutchin's store; mine,	314; 315
Little (Dr.),	95	McDowell (J.),	163, 164
Little Redstone creek,	21	McFadden (H.),	285
Little Sewickley creek,	5, 15, 16, 306	McGee's run,	5, 279, 283
Lindsay opening,	299	McGuire's crossing; run,	276 ; 391
Line ferry,	19	McIntyre property,	267
Lisbon (Irwin) syndical,	20, 21, 28	McKain's station,	371
Lloyd, Huff & Co.,	270	McKee's (Mr.), opening,	323
Lockhart station (A. V. R. R.),	370	McKeesport,	4, 373, 380
Logan's hollow; mine,	376; 390	McKelvey, (Berely &),	332
Lomison (Dr. H. G.); pits; run,	57, 285; 279	McKinney's fork,	378
Long (S.) pit; mine; run,	218, 298, 334, 325; 338	McLaughlinton,	331, 367
Louck's property,	258	McMath's school-house,	390
Loughner's house,	334	McMillan's mine,	361
Low (Jonathan),	150	McNeill's mine,	376
Lowry's (R.) pit,	298	McQuaid (Col.),	316
Loyalhanna river; gap; station,	5, 11, 16; 107; 19, 284	McVey's (J.) house; opening,	357
Loyalhanna Coal and Coke Com- pany,	280, 281	Meek (Mr.),	102
Loyalhanna township, Westmore- land county, (L. T. w.),	316	Methodist Episcopal church,	363
Luzerne township, Fayette coun- ty, (L. T.),	237	Mehaffy's opening,	332
Lycippus,	269	Mennonite chapel,	254
Lyon (W. M.); mill; run;	210 ; 227; 330, 332	Merrittstown,	26, 28, 230
Lynch (Mr.),	202	Messmore's mill,	244
Mack's mill,	244	Mettenzuey (Phillips &)	364
Mackie's opening,	382	Middle valley; Middle run,	5; 21
Madison,	302	Miller (H.); pit; run,	221; 221; 289
Manellen township, Fayette coun- ty, (M. T.),	218	Millsborough,	237
Manor church; shaft; station,	335 ; 329; 89, 48, 347	Millwood Coal Company,	57
Markle's paper-mill,	21, 350, 352	Millwood station (P. R. R.),	288
Mason (Mr.),	387	Mitchell's (Mrs.) mine,	353
		Monahan's bank,	252
		Monongahela city; river valley,	22 379; 2
		Monongahela Valley Railroad,	7
		Monroeville; village, 391; 152, 157, 164	
		Monterey,	22
		Montgomery (Mr.); coal bank, 326; 363	
		Montgomery's (J. M.) mine,	361
		Moore's (A.) residence; opening, 363;	334

	Page.		Page.
Moreland's hill,	177, 178	Old Vernon furnace; mines, . . .	195; 124
Morgantown; road,	16; 31, 133	Osceola,	382
Morris cross-roads,	133, 134, 136	Overton,	267
Morrow's pit,	388	Owen (Dr. D. D.),	94, 105
Moser, (Mr.),	151	Pack Saddle mountain	292
Moss Side station, (P. R. R.) . .	350	Painter's (Col. I.) salt works; opening,	308, 309; 355
Mount's creek,	4, 11, 104, 191	Paintersville,	309
Mt. Braddock,	50, 178	Pangborn's run (Watson on map),	370
Mt. Pleasant,	4, 197, 256, 259	Parkhill's mill,	31, 84, 210, 227
Mt. Pleasant branch P. & C. R. R.,	199	Parnassus station (A. V. R. R.), .	370
Mt. Pleasant furnace; road, . . .	120, 262; 191	Parr's (Mr.) opening,	287
Mt. Pleasant township, West- moreland county, (Mt. P. T. w.),	4, 6, 256	Patterson (J.); property; run, . .	218, 287; 329; 17
Murrysville,	17, 327, 331	Patton township, Allegheny coun- ty (P. T. a.),	391
Murphy (Mr.); pit,	281, 282	Paull, Brown & Co.'s coke-works, .	180, 184
Myers (Mr.),	266	Paynter (S. B.),	235, 236
National road; summit,	3, 142, 158; 12	Pechin (Mr.),	116
Negro mountain,	62	Penn; station (P. R. R.)	51; 300, 332
Nessler's store,	269	Penn Gas Coal Company,	60, 301, 333, 338
Neudorfer's property,	329	Penn mine; shaft,	333; 345
New Alexandria,	20, 177, 178, 311	Penn township, Westmoreland county (P. T. w.),	331
Newburgh,	18	Penn township, Allegheny coun- ty (P. T. a.),	387
Newcomer (Mr.),	178, 244, 247	Pennsylvania R. R. Co.,	7, 323
New Derry,	284	Pennsville,	194
New Geneva,	45, 46, 112, 135, 136, 249	Perry township, Fayette county (P. T.),	202
New Salem; road,	49, 153, 313; 219	Perryopolis,	202
New Texas,	388, 389	Peter's creek,	18, 373, 381
Newton,	331	Phillips & Mettenzuey,	364
New York and Cleveland Gas Coal Company,	384, 388, 389, 391	Phillips' pit,	386
Nichols (Mr.),	274; 282	Piedmont (sandstone),	82
Nicholson township Fayette county,	145; 248	Pierce's fork,	374
Nine-Mile run,	269, 386	Piney Knob,	159
Noel's (Mr.) bank,	281, 282	Pin Hook (anticlinal),	17, 373
Norcross's (W.) property,	228	Pinkerton (Fulton &),	351
Norris's (Mrs.) opening,	288	Pittsburg (city of),	381, 386
North Huntingdon township, Westmoreland county (N. H. T. w.),	4, 327,	Pittsburg and Connellsville R. R.,	7
North Union township, Fayette county (N. U. T.),	124, 161	Platt (F.),	30, 41, 42, 53
Nazum's mills (W. Virginia), . .	58	Platt's coke report,	360
Oakland post office,	17, 326	Platt's Report on Armstrong county,	81, 324, 327
Ohio river,	5	Platt (W. G.),	30, 41, 42
Olipphant (J.),	146, 149, 164, 345	Pleasant Unity,	19, 258
Olipphant (Mrs.); (F. H.); (F. H., Jr.),	136; 113; 344	Plum creek; church,	388, 389
Olipphant's (F. H.) furnace, . . .	121, 146		

Page.	Page.
Plum township, Allegheny coun- ty (Pl. T. a.), 389	Rubble's run, 3,137
Pocono (rocks), 105	Rubright's mill, 324
Point Marion, 135	Ruff (C.); bank, 307; 205,286
Pore bank, 354	Rugh's (J.), pit, 298,315,323
Port Perry, 283	Rush run, 238
Port Royal; station, 21; 357,358	Safford (Professor), 94,105
Porter (Mr.), 241	Salem township, Westmoreland county, (S. T. w.), 311
Poundstone (J. H.), 241,247	Salisbury (basin), 30,40
Possum creek, 177,178	Saltsburg (anticlinal), 14,133,151
Pottsville (conglomerate), 91	Saltsburg Coal Company, 60,322
Preston (axis), 18	Saltsburg and Pittsburg road, 321
Presbyterian church, 356	Salt-works, 307
Price (Mr.) opening, 229; 373	Sanders (R. H.), 44, 54
Pridevale property, 122,132	Sandy creek, 388
Provence (J. Y.), 254,255	Sapper (Mr.), 24
Pucketta creek, 17,326,367,370,390	Saxman (H., junior) & Co., 286
Rambaugh's (J.), house; ferry; bank, 259,257; 323; 269	Saxman's run, 279,281,285
Rameley's post office; mine, 328; 390	Schellenberg (F. Z.), 340,346
Ramsay (Mr.), 314	Schellenberg's map, 338
Ray opening, 343	Scottdale, 265
Redstone creek, 3, 11,13,16,34,45,75,124,151,154,159	Scott's run; pit; mine, 117; 374; 373,377
Redstone flouring-mill; post office, 210; 209	Seanor (W.); opening, (H.), 58; 287
Redstone township, Fayette coun- ty (R. T.), 225	Searight's, 220,222,227
Red Lion post office, 21,209	Seaton's (I. T. S.), pit, 55
Reed's mill, 317,325	Sewickley creek, 4,14, 41
Rhodes' opening, 355	Sewickley township, Westmore- land county, (Sew. T. w.), 4,350
Rich mountain, 93	Shaffer's property; run, 261; 322
Ridgeway (Mr.), 88	Shafton, 347
Riddle's (Judge) house, 328,329	Sharon (coal group), 103
Ringer's (Mr.) property, 316	Sharp's mine, 389
Ritchie (Mr.), 154	Sharpless' mill, 217
Ritenour's mill; bank, 167,169; 124	Shaw's opening, 312
Rittenhouse (Mr.), 217	Shearer's hollow, 214
Roaring run; (anticlinal), 17,317; 349	Sheplar's Knob; pit, 26,365; 366
Robertson's (W.) bank, 354,355	Shields' bank, 308; 312
Robinson (Mrs.); (Mr.); mine, 144; 323; 343	Shipley bank, 165
Rogers (Prof. W. B.), 19,96, 102,104,105,110,117,122,123,132,149	Shirley (J.), 277
Rogers (Prof. H. D.), 51, 61, 62, 96	Shuey's opening, 295,297,299
Rose's (J.) pit, 331	Shupe's opening, 355
Ross (H. L.), 255	Shute's run, 124,163,164,167,168,169
Rostraver post-office, 363,366	Simmons, 121
Rostraver township, Westmore- land county, (Ros. T. w.), 360	Simpson's bank, 303
Round Hill church, 374,375	Six-Mile ferry, 385
	Sloan & Freeman, 234
	Smiley's hill, 124,168,169,174,175
	Smith (Professor L.), 105
	Smith (C.), opening, 34; 312
	Smith's station, 354,355

	Page.		Page.
Smithfield,	143,145	Thompson (Dr.); (J. M.); (Mrs.)	136; 219; 224, 324
Snake Den (ore),	119,149	Thompson's run,	384,388
Snodgrass' (James) mill,	15, 79, 817, 320, 324	Townsend (Aaron),	60, 203
Snyder (J.),	151, 281	Trauger (Mr.),	269
Soda-Works station,	371	Tree's mill,	314, 316
South Huntingdon township, Westmoreland county (S. H. T. w.),	4, 354	Trout mine,	325
South Union township, Fayette county (S. U. T.),	13, 151	Turtle creek; station, 5, 329, 381, 391; 22	
Southwest Pennsylvania Railroad,	295	Turkey nest,	107
Speer, Clark & Co.,	193	Tygart's valley; river,	85; 101
Springer's opening,	169, 222	Tyrone Presbyterian church,	198
Springhill; furnace; mines; station,	121, 124, 133, 137, 141; 104; 381	Tyrone township, Fayette county (T. T.),	197
Springhill township, Fayette county (S. T.),	6, 13, 133	Union depot in Pittsburg,	386
Spruce run,	14	Uniontown; (coal bed); road,	37, 152; 36; 137
Squirrel hill,	386	Unity township, Westmoreland county (U. T. w.),	4, 268
St. Clair,	51, 270, 279, 280	Upper Middleton,	217
St. Paul's church,	258	Valley Falls (B. & O. R. R.),	93
Stairs (I. F.); (J.),	121; 265	Vance's mill,	214, 217
Staunton and Parksburg pike,	81, 98	Vankirk's (E.) mine,	230, 231, 377
Steel (J.); (Mrs.)	211, 326; 328	Vernon mines,	127
Stephens (Mr.),	207	Versailles township, Allegheny county,	390
Stewart, Dickson & Co.,	381, 382, 387	Victor iron-works,	150
Stewart's opening,	144, 382, 386, 390	Wagnerville,	265
Stewart's station, P. R. R.,	337, 350	Walters (E. W.); opening, 253, 255; 178	
Stickle hollow,	202	Walkinshaw (Mr.),	283
Stiger's (Adam) pit,	329, 330	Wallace farm and pit,	368
Strader (Wood & Co.),	376	War Branch run,	252
Strickler (J.),	198	Warden (S.) & Co.; works, 265, 267; 258,	
Struble (A.),	27, 239, 245, 246	Washington township, Fayette county (W. T.),	207
Stoner, Hitchman & Co.,	266, 267	Washington township, Westmoreland county (W. T. w.),	325
Stonerville,	267	Watson's knob,	218, 247
Stoney run,	279	Watt's station,	180, 182
Stout's opening,	314	Waverly Coal and Coke Company,	355
Sturgiss (Mr.),	134	Waynesburg anticlinal; synclinal, 17, 349; 22	
Stuyvesant's (John) house,	321	Waynesburg sandstone; coal; lime,	31; 32; 35
Sullivan (W.),	165, 168	Webster,	17, 360
Summit house,	166	Weddell's bank,	377
Sutton's (Mrs.) bank,	145	Weisters cross-roads,	326, 331
Swan heirs' pit,	57	Weltner's house,	246
Swank (Mr.),	192	Westmoreland Coal Company,	24, 60, 256, 329, 333, 338, 381
Tarentum,	370	West Middletown,	78
Tarr (J.); Tarr's station,	266; 19, 265	West Newton; pike,	356; 44, 265, 296
Telegraph road,	237		
Ten Mile creek,	17, 237		
Thomas' (Mr.) bank,	289		

	Page.		Page.
West Pennsylvania Railroad, . . .	7	Woodward (J.),	220, 247
White (Professor I. C.),	370	Woolford's old mill,	323
White & Heath,	357	Woolsey mines,	254
White Rock station,	192	Work's (Mrs.); distillery, . .	218; 213
White's station,	14, 319	Wuth (Mr.),	184
Whitsels run,	205	Wyckoff's deserted pit,	377
Wiley's run,	376	Wymp's Gap,	138
Wilhelm mine,	53	Yanger's land,	172
Wilkinsburg,	384	Yetter's opening,	387
Wilkins township, Allegheny		York's run,	143, 252
county, (W. T. a.),	383	Youngstown,	269
Willard's mine,	315	Young's mill,	229
Wilson's run,	309	Young's run,	313
Winebiddle's property,	386	Youghiogheny Coal Company, . .	357
Woods, Strader & Co.,	376	Youghiogheny river,	2, 11, 16
Woods' mill; bank; distillery, . .	15;	Youghiogheny shaft,	344, 345, 346
221, 222, 224, 234; 224		Zarley's house,	253

PART II.—Coal Beds and Limestones.

	Page.
UPPER BARREN MEASURES described Ch. IV,	25
Sparingly represented in the district and ill exposed,	8
<i>Greene County Group</i> , absent from the district,	125
Section, fig. 1,	25
<i>Washington County Group</i> , in Lisbon trough,	9
Full thickness,	21
<i>Upper Washington Limestone</i> , VI., in Rostraver T.,	26
On highest knobs along Blairsville trough, (D. T.),	177
Thick; Sheplar's Knob; (Rost. T. w.), 540' + river,	365
Sandstone under U. W. L., Dunlap's Cr. (Reds. T.),	26
In huge blocks; 360' + Wayne. Coal,	226, 227
Sandstone over Jolletstown Coal, Nat. R., (R. T.),	227
<i>Jolletstown Coal</i> on Nat. R. (Redstone T.),	26, 226
Coal high in U. P. C. M. Moreland's hill, (D. T.),	178
<i>Middle Washington Limestone</i> , IV, absent in district,	26, 27
<i>Limestone</i> , III., ferruginous, Nat. R., (R. T.),	27, 226
<i>Lower Washington Limestone</i> , II, (Redstone T.),	27
On high hill between forks of Redstone creek (J. T.),	212
On Dunlap's creek (R. T.),	231
Seen only in fragments north of Brown's run (G. T.),	245
On hills south of Shafton (N. H. T. w.),	348
Dark, ferruginous, on the pike (S. H. T. w.),	356
At Beezel's, W. Newton, (Ros. T. w.),	366
Sandstone over Washington Coal, pike, (S. H. T. w.),	356
<i>Washington Coal</i> ; distribution of its areas,	27
Only 9' in S. Huntingdon T.,	28
Caught in highest hills of (D. T.),	178
Crop, 500' + Monon. River, Downer's run (W. T.),	209
Between forks of Redstone (J. T.),	211, 212
Section, crest of Elliott's hill, (J. T.),	212
West border of (M. T.); Nat. road (R. T.),	221, 226
On Dunlap's creek (7'?) in (R. T.),	231, 232
Smut, Heistersburg (L. T.); N. of Brown's run (G. T.),	240; 245
On Heistersburg road, 140' + Wayne Coal	248
Not detected along trough in (Sew. T. w.)	354
Smut on pike (9' alternations) in (S. H. T. w.),	356
On Port Royal road (S. H. T. w.) Section (8' 10''),	357
Section (9' 3'') at West Newton, 440' + Yough. river,	365
Great smut at Perryopolis road (Ros. T. w.),	366
At Beezel's (7' of coal) W. Newton (Ros. T. w.),	366
<i>Little Washington Coal</i> only seen on pike (S. H. T. w.),	28, 356
<i>Limestone I. b.</i> wanting to the district,	28, 226
<i>Limestone I. a.</i> seen only twice; Nat. road (R. T.),	28, 225
On Dunlap's creek (R. T.); (Mt. Pleasant T. w.),	231; 259
Bright yellow (3' thick) (S. H. T. w.),	358, 359
At Beezel's, W. Newton, (Ros. T. w.),	366
<i>Waynesburg Coal</i> , a., persistent through the district,	28
Often seen with a sandstone roof,	28
In the high hills of Mt. Pleasant T., Dunbar T. and Mt. Union T.,	26
Perhaps the bed near Mt. Braddock (D. T.),	178

	Page.
Seen in (J. T.); 2' near Cook's mills (R. T.),	211; 227
55' below Wash. C. B. (R. T.); Brown's run (G. T.),	229; 242, 243
North of Brown's run; 35' + Wayne C. (Mt. P. T. w.),	245; 258
80' below Wash. C.; 135' below Wash. C. (S. H. T. w.),	358
Seen at Beezel's, with Waynesburg Coal, (Ros. T. w.),	366
Not seen on high knob of Kelley's run (E. T. a.),	379
<i>Waynesburg Sandstone</i> described in Blairsville trough,	31
Everywhere in Lisbon trough; not seen in Greensburg trough,	32
Some layers of conglomerate, (45' thick) Nat. R. (R. T.),	226
On Dunlap's Cr. (R. T.); (15') directly on Wayne C.,	230, 231
Coarse, micac., concentric, small grains of feldspar,	236, 237
Cliffs (80') N. of Brown's run (G. T.); 120'—Wash. C.,	246
Soft, cross bedded, 65' + Wayne C.; 325' + W. Newton depot,	356
UPPER PRODUCTIVE COAL MEASURES, isolated areas,	8
Described in Chapter V. General section,	30, 31
In Springhill T.; general section near Smithfield,	133; 144
Sections in (S. U. T.); on Shute's run (N. U. T.),	155; 163
Section above Uniontown C. nowhere good in (D. T.),	176
Sections at Dunbar, Fig. 20; Browneller's run (P. T.),	179; 204
General section on Redstone creek (F. T.), Fig. 26,	215
General section on Dunlap's creek (B. T.), Fig. 27,	233
General section at New Geneva (N. T.), Fig. 7,	249, 250
Sections at Mt. Pleasant; Pleasant Unity, Fig. 31,	258
Section on Penn. R. R. (D. T. w.),	279
General section between Greensburg and George's Stat.,	294, 295
Section (of 130' + P. C. B.) in bore hole,	329
Section (doubtful) in borings at Manor church,	335, 336
Section (of 133') in shaft south of Irwin,	344
Section in Penn shaft No. 1, fig 46, (N. H. T. w.),	345
Section opposite Monongahela City,	379, 380
In crests of divides (100') back of Pittsburg,	387
<i>Shales</i> (with plants) between Wayne. SS. and C.,	238
<i>Waynesburg Coal Bed</i> , persistent, described,	32, 33
Mined in Mt. Pleasant T.; principal bed in Lisbon trough,	33
Usually has a triple section; in Somerset Co.,	33; 41
N. Georges' T.; near Uniontown; near Mt. Braddock,	143; 154; 178
(4') head of Downer's run (W. T.); in (J. T.),	209, 211
Thin on the Redstone Creek hills in (J. T.),	213
Too high for the hilltops on the Monongahela, (J. T.),	213
Smut, New Salem; 4' ? on Redstone (M. T.),	220; 223, 224
330'—SS. blocks on Redstone—Dunlap divide (R. T.),	225, 226
4' 3" Parkhill's mills, Redstone; "Brick" bench, (R. T.),	228
80' + Little Wayne C.; Section (R. T.),	228; 229
"Brick" bench (4") constant; Section on Dunlap's Cr.,	229; 230
"Brick" (8") always worthless; 8' on Dunlap's Cr. (R. T.),	230; 231
Section on Dunlap's Creek, (R. T.),	231
5½' on National road, (B. T.),	236
Principal bed of the township on Monongahela (L. T.),	237
Sections at Heisterburg; ¾ mile back; Merrittstown,	237, 240
Passes under Dunlap's creek water at forks,	239
8' of coal between Masontown and McClellandtown,	242

	Page.
7' on Brown's run (G. T.); Section north of run,	243, 245
6' 9" N. of Brown's run; Section on Middle run (G. T.),	246
In Mt. Pleasant T.; Section of <i>W. Group</i> , (U. T. w.),	258; 273
On east side of (E. H. T. w.),	268
4' 5", slaty; 280' + Pittsburg Coal Bed (U. T. w.),	273; 274
Only 170' (?) + P. C. B. in (D. T. W.); in (H. T. w.),	284; 304
60' + Uniontown C. (or 240' + P. C. B.) south of Irwin,	344
Exposed on the Port Royal road (S. H. T. w.),	357
135' — Washington C.; 15' + Wayne. L. (S. H. T. w.),	357
2½', only 260' + P. C. B., W. Newton pike (Ros. T. w.),	363
Lenity school-house; Beezel's (3') — (Ros. T. w.),	365; 366
250' + P. C. B. at school-house (E. T. a.),	375
<i>Little Waynesburg Coal Bed</i> described generally,	34, 35
Section, Baptist Ch.; 2½', good, directly on W. L. (R. T.),	228
A dark fissile shale, on Wayne. L. (I. T.),	240
2½' as seen on Brown's run (G. T.),	243
A true coal bed, but thin, (Mt. P. T. w.),	258
<i>Waynesburg Limestone</i> very persistent in KK.,	35
Erroneously spoken of as local in K. report,	35
8' to 35' thick; makes superior lime,	35
Not positively identified in Greensburg trough,	35
In Georges T.; disappears going up Downer's run, (W. T.),	209
In M. T.; most easterly exposure,	220, 221, 222
Half mile north from National road (M. T.),	224
25' — Waynesburg Coal in Nat. road (R. T.),	226
Birdseye limestone (G. T.); fragments (Mt. P. T. w.),	243; 258
In Pleasant Unity hill tops,	274
5' thick; 90' (?) + Great Limestone (H. T. w.),	304
7' pure in South Huntingdon T.,	357
Port Royal road (S. H. T. w.); Rostraver C. H.,	357; 363
Lenity school-house, (Ros. T. w.),	365
9' thick; 20' — Wayne C., West Newton pike (Ros. T. w.),	363
Dark; on hill top, 275' + P. C. B. Monongahela City,	380
8'; on hill tops; 170' + P. C. B. (Wil. T. a.),	385
Limestone, reddish, 250' (?) + P. C. B. around Harrison City,	335
Limestone, thin, blue, laminated, local, over U. C. B.,	36; 240
<i>Uniontown Coal Bed</i> , irregular and valueless,	36
Persistent in Lisbon trough; not seen in Greensburg trough,	36
In Somerset county; in Georges T.; at Uniontown,	41; 143; 152
Section, north of National road, (S. U. T.),	153
Section at Uniontown (N. U. T.); without limestone,	162; 163
Near New Alexandria (D. T.),	177
A thin black shale on Downer's run (W. T.),	209
Not exposed on the Monongahela river: (J. T.),	213
Absent all along Redstone creek in (R. T.),	228, 229
20" and 30" as exposed on Dunlap's creek (R. T.),	230
National road (B. T.); Bull Run hill (L. T.),	236; 240
2½' (?) on Brown's run (G. T.); in (Mt. P. T. w.),	243; 259
5' to 30' + Great Limestone in a short distance (D. T. w.),	284
(?) (5") 140' + P. C. B. on Turtle creek,	329
South of Irwin; (?) (162' + P. C. B.) W. of shaft,	344; 347

	Page.
Not far over Great Limestone, Meth. Epis. Ch. (Ros. T. w.),	363
Resting on the Limestone, E. of Houseman's shaft,	365
Smut seen over the Limestone (E. T. a.),	375
One mile south of Elizabeth,	378
Coal (3' 4") 142' + P. C. B. persistent around Greensburg,	296
<i>Great Limestone</i> , described as a whole,	37, 38
8', thin, ferruginous, earthy, in West Virginia,	38
148' (61' of L. in 6 layers) ferr. argill., Greensburg trough,	39
"120-foot Limestone" of the Westmoreland miners, because its base is 120' above Pittsburgh Coal,	40
In Somerset county it is not a cement bed,	40, 41
Georges creek; National road; north of Uniontown,	143; 152, 153; 162
Leimont furnace; section of group on Hill farm (D. T.),	169; 179
Non-fossiliferous in (P. T.); 65' in (J. T.),	204; 211
Disappears up Downer's run (W. T.),	209
Little Redstone north fork (J. T.); Cook's mills (R. T.),	213; 227
160' + P. C. B. at Masontown (G. T.),	242
In ridge dividing Jacob's creek and Cat's run (N. T.),	254
Fragments S. of Tarr's Station P. R. R. (E. H. T. w.),	266
Fragments 1 mile N. of Stonersville,	267
Only 1½' thick, hard, non-foss., 170' + P. C. B. (D. T. w.),	280
70' + Redstone C. at New Derry,	283
Diminishes to only 1½' in (D. T. w.)?,	284
Three layers 170', 120' 60' + P. C. B. (D. T. w.),	284
Described (with other limestones) in (H. T. w.),	295, 296
Base 120' + P. C. B., Westmoreland Co.'s shaft,	303
Eroded soon after its deposition, at Penn Stat.,	303
12' thick (H. T. w.); 8' 3" thick, 140' + P. C. B.,	304; 329
Contains <i>ostracoids</i> on Turtle creek,	346
Varies rapidly from 7½' to 28', near West. Co. shaft,	347
At Port Royal (S. H. T. w.),	358
40' exposed for two miles, pike, W. Newton,	362
80' + Redstone C., W. Newton pike (Ros. T. w.),	363
50' + Redstone C. on Hayden's run (E. T. a.),	377, 378
Between Watson's and Kelley's runs (E. T. a.),	378
190' + P. C. B. opposite Monongahela City,	380
Thinner on the Greensburg pike (V. T. a.),	383
6' thick, 150' + P. C. B. ¾ mile east of Ref. Ch. (P. T. a.),	388
<i>Uniontown Limestone</i> = <i>Upper Div. Great L.</i> ,	37
Well marked in the Lisbon trough; not recognized in the Greens- burg trough; disappears northward,	37
At Uniontown, and east of it; Section,	152, 153; 162
Not seen with the Uniontown C. on Schute's run (N. U. T.),	103
In (M. T.); on Bull run (L. T.),	222; 240
Subdivided in (Mt. P. T. w.),	259
148' + P. C. B. south of Irwin on P. R. R.,	344
(?) (7' 5") 133' + P. C. B. in Westmoreland shaft,	347
15' on Sewickley Cr., Markles mill (Sew. T. w.),	352
40' exposed, very good top layers, W. New. pike (Ros. T. w.),	362
Very ferruginous at Meth. Epis. Ch. (Ros. T. w.),	363
14' at the Round Hill church (E. T. a.),	375

	Page.
Buff layer at base 208' + P. C. B. Mononga. City,	380
Sandstone between Upper and Lower divisions of G. L.,	38
Coal bed over the Lower Division of Great Limestone,	153
<i>Lower Division of Great Limestone</i> ; subdivided,	37
Persistent in all the troughs; very variable; thickest in Lisbon trough; thins northward; split into 4 layers in Fayette county,	88, 39
On Nat. road (N. U. T.); Magnesian on Schute's run,	161; 164
Section between Frost's Cr. and Mt. Braddock (D. T.),	178
On Downer's run (W. T.); Redstone Cr. (F. T.—J. T.),	209; 210
90' thick, a marked feature along Monongahela,	213
Double on Redstone Cr.; fragments in (F. T.),	215, 216
70' thick on Monongahela river (L. T.),	238
25' + Sewickley Coal bed at Pleasant Unity,	274
25' thick, 87' & more + P. C. B. on Turtle creek,	329
14' thick, 92' & 108' + P. C. B. south of Irwin,	344
85' thick as it sinks into the Sewickley creek above and below Bell's mills,	352
On the West Newton pike (Ros. T. w.),	360
55' thick, on Youghiogheny river (Ros. T. w. line),	367
Forms the roof of the Sewickley C. (E. T. a.),	375
Base 120' + P. C. B. opposite Monongahela City,	380
Sandstone over the Sewickley Coal bed on Nat. road,	152
Sandstone (6') 130' to 140' + P. C. B. at St. Clair,	280
<i>Sewickley Coal Bed</i> described in Somerset Co.,	41, 42
Absent from Ligonier Valley (?); in Blairsville trough,	42
"Five Foot Seam" south of the Youghiogheny,	42
Badly identified in the Greensburg trough,	43
Traceable to Sewickley creek, thins northward,	43
Thins out north of the Penn. R. R.,	42, 43
This name erroneously given in the old reports to the Redstone Coal Bed on Sewickley Cr.,	43
Near Morgantown; 4' and 5' thick,	134; 136; 137
In Georges T.; 6' on York run, as mined,	144; 145
Out-crop in Georges T.; on Nat. road (S. Un. T.),	148, 149; 152
East of Uniontown; North of Uniontown,	152; 155
Shute's run (N. U. T.); 5' (?) at Monroe; Lemont F.,	164; 165; 169
Dunbar; mere shale on Browneller's run (P. T.),	180; 204
2½' on Little Redstone Creek,	209
2' on Redstone, ½ mile below old paper mill (J. T.),	210
In long cut on Redstone R. R. very irregular,	210
Thin and rarely opened on the Monongahela (J. T.),	213
Irregular on Redstone (F. T.) 120' + P. C. B.,	216, 217
Rises from Redstone 2 m. bel. Parkhill's mills (R. T.),	227
Entirely wanting at Brownsville and up Dunlap Cr.,	234
3' at Lock 5; 6' at above Brownsville (L. T.),	238
98' + P. C. B. on Cat's run (G. T.),	241
McClellandtown (G. T.); New Geneva (N. T.),	246; 249
5' 3'', good, Woolsey's mines, head of Fred's run (N. T.),	254
Only shale, on Fishpot L. 65' + P. C. B. (N. T.),	254
90' + P. C. B.; (1½') 120' + P. C. B. (Mt. P. T. w.),	254; 259
2' thick (E. H. T. w.); 40' + Redstone C.,	266; 267

	Page.
4' thick at Pleasant Unity,	274
Two thin layers, 8 apart, 128' and 131' + P. C. B., St. Clair,	280
113' + P. C. B. shaft at Loyalhanna Station,	280
(2') 35' + Redstone C., Saxman's run (D. T. w.),	282
Not to be seen north of Penn. R. R. in (D. T. w.),	283
(2½') only rich black slate, floor of the Great L. on Sewickley Cr. (Sew. T. w.),	332
Floor of the bed, a characteristic flagstone,	352
(4'') the floor of G. L. at Port Royal (S. H. T. w.),	358
(4'') 3' under G. L., on W. Newton pike (Ros. T. w.),	362
Black slate, 45' + Redstone C., W. New. pike,	363
Not shown (at 130' + P. C. B.) in Houseman shaft,	364
(0' to 3'') on the Youghiogheny, floor of G. L.,	367
1' black slate, Pierce's fork, Howell's run, (E. T. a.) and here also the floor of the Great Limestone,	375
<i>Flagstone</i> , characteristic floor of Sewickley C. B.,	352
Over the Fishpot Limestone (B. T.),	234
"Flag Rock" over Redstone C., W. Newton pike (Ros. T. w.),	362
SS. massive, 50' + Redstone C., local, Howell's run (E. T. a.),	374
<i>Fishpot Limestone</i> (Sewickley L. of Somerset report H. H. H.) the floor of the Sewickley Coal bed,	41, 43
In the Salisbury basin; Ligonier Valley; Blairsville, &c.,	44, 45
Good flux in N. Union T.; Valueless in Greensburg trough,	45
Wanting sometimes; thins to nothing northwards,	45
Wanting in Lisbon trough north of Sewickley Cr.,	46
5' very ferriferous, at Smithfield; in (S. U. T.),	144; 153
N. of Uniontown; quarried at Lemont Furnace,	156; 169
Exposed under S. C. B. at Braddock's Stat. (D. T.),	179
(?) On divide in (P. T.); poor on Browneller's run,	203; 204
Near bridge above Lyon's mill, Redstone Cr. (J. T.),	210
35' thick in (J. T.); 30' thick along Monong. Riv.,	211; 213
Top 85' + P. C. B., (F. T.); 35' thick at Brownsville,	215; 233
Ferruginous throughout on Redstone Cr. (B. T.),	236
Quarried at McClellandtown (G. T.),	246
Exposed on Uniontown and McClellandtown road (G. T.),	247
At New Geneva (N. T.); wanting on Saxman's run,	240; 282
Floor of Sew. C. B.; also 15' under Sew. C. B. (N. T.),	254
Mere nodules at St. Clair; last exhibition going N.,	280
26' thick, ferriferous, 68' + P. C. B. around Greensburg,	297
(?) Error of measurement (14' thick) 29' + P. C. B., Penn shaft,	345
(20') 65' — Great L., Port Royal (S. H. T. w.),	358
Apparently absent on W. Newton pike (Ros. T. w.),	362
Seen on Pierce's fork of Howell's run (E. T. a.),	374
8' to 10' thick, 70' + P. C. B. (Pl. T. a.),	390
<i>Redstone Coal Bed</i> described throughout the district,	46, 47
Mistaken for the Sewickley coal, at Dunbar,	43, 50
Persistent in Lisbon trough far north of P. R. R.,	47
Near Morgantown; Springfield; E. of Uniontown,	134; 144; 152
Thin and no limestone, Burchinal's, Springhill T.,	136
50' + P. C. B. Morris X roads, Springhill T.,	137
(19'') Uniontown; Shute's run (N. U. T.),	156; 164

	Page.
(6") at Lemont Furnace; at Dunbar,	169; 180
(12") 35' + P. C. B. Braddock's Station (D. T.),	179
(4½') Youghiogheny (P. T.); mined, Perryopolis,	204; 206
Cakes less than P. C. B., but more ashy,	204, 205
50' + P. C. B. on Whitesell's run (P. T.),	205
40' + P. C. B. on Little Redstone Cr. (W. T.),	208
(3' to 4') near Fayette city (W. T.),	209
(3') 40' + P. C. B. (J. T.); 2½' to 4', Mon. Riv.,	211; 213
In (F. T.); 25' + P. C. B. (M. T.); on Redstone Cr.,	215; 222, 223
(6" to 12") black shale, hard, Dunlap's Cr. (B. T.),	232
Fair coal at mouth of Redstone; shale, up Mon. R.,	236
Black shale (L. T.); McClellandtown,	238; 246
7 8' only + P. C. B. Masontown; 20' + P. B. C. opposite,	242
(4') black shale on R. L. S., of Dunlap's Cr. (G. T.),	247
(4') New Geneva (N. T.); (3') shale 14' + P. C., Core's,	249; 254
45'—S. C. B. (N. T.); (4') in (E. H. T. w.),	254; 266
"Four-foot vein" (Mt. P. T. w.); 2'—4', bony,	260
Section of Redstone measures along S. W. Penn. R. R.,	267
65' + P. C. B. S. of Tarr's Stat. (E. H. T. w.),	267
Near St. Clair (D. T.); black slate in (U. T. w.),	270; 274
Thin, good, persistent in St. Clair,	280
(3") 97' + P. C. B. on Saxman's run (D. T. w.),	282
(3') 80' + P. C. B. Greensburg and Madison road,	304
65' + P. C. B., N. of New Salem,	315
65' + P. C. B. small (W. T. w.),	326
(1' 3") 73' + P. C. B. on Turtle Creek,	329
80' + P. C. B. thin, shaly, Penn Station,	334
(1' to 3') 48' + P. C. B. in Yough. Shaft,	345
A trace, 80' + P. C. B. in Penn Shaft (N. H. T. w.),	345
(2' 6") exposed on Turtle Cr., near Penn shaft 1,	346
Wanting in Westmoreland shaft,	347
(4') about 50' + P. C. B. Bell's Mills (Sew. T. w.),	351, 352
(3') good, east side of Sewickley township,	353
50' + P. C. B. on pike; water's edge, Smith's St.,	356, 357
Sections of 3' to 4', 1 m. from Smith's S. (S. H. T. w.),	358, 359
60' + P. C. B. Lee's Mill (S. H. T. w.),	359
(0' to 4') old openings, W. Newton pike (Ros. T.),	360
Only shale, no SS., no L., W. Newton pike,	361
Roof "flag rock" south of W. Newton pike,	362
(3' 8") 10" of cannel on top, ½ m. from Webster,	363
(3') 60' + P. C. B. in Houseman shaft (Ros. T. w.),	364
53' + P. C. B. on Yough. county line,	366, 367
(4') 60' + P. C. B. on Howell's run (E. T. a.),	374
(3' to 4') Logan Hollow (E. T. a.); Hayden's run,	377
56' + P. C. B. opposite Monongahela City,	380
Black slate along Greensburg pike (V. T. a.),	383
Black slate, 40' + P. C. B. (Wil. T. a.),	385
Usually rich in sulphur,	377
No coal for 50' over P. C. B. Larimer Station,	339

	Page.
‡ This may be the double bed (4" (4') 12") 15' only above P. C.	
B. in Greensburg Section. It is single 18' + P. C. B.; and at	
tunnel only 9' + P. C. B.,	297
Represented by fragments of Coal in the lower 6' of SS. mass	
over Great Limestone (Erosion),	304
<i>Redstone Limestone</i> , described as very variable,	48
In Salisbury basin also variable,	44
Absent at Burchinell's, Springhill T.,	136
At Lemont F.; Braddocks Stat.;	169; 179
Very ferriferous (P. T.); McClellandtown (G. T.),	205; 246
Yellow limestone south of Dunlap's Cr. (G. T.),	247
Absent in (Mt. P. T. w.); reddish (E. H. T. w.),	260; 267
Very ferriferous (E. H. T. w.),	267
Vanishes northward as calcareous clay, St. Clair,	280
Very variable and often absent north of Sewickley,	345
In river bed at Smith's Station (S. H. T. w.),	359
Represented by nodules in shale, W. Newton p.,	363
(8') thick, ferruginous, 4' under R. C. B., Yough.,	367
(1' 6") 46' + P. C. B., opposite Monongahela City,	380
Absent along the Greensburg pike in (V. T. a.),	383
<i>Dunbar Coal Bed</i> . Local? (4') at the furnace, 31' under the Red-	
stone C. B. See Fig. 4,	50
<i>Dunbar Limestone</i> . Local? Under Dunbar C. B. at the furnace. See	
Fig. 4,	50
<i>Pittsburg Sandstone</i> (=Upper Pittsburg Sandstone.)	
25' well shown at Smithfield (Georges T.),	145
40' thick, over Pittsburg C. B. Lemont Furnace,	170
Remains above R. R. for a mile west of Latrobe,	270
Base curved at Beatty's Station (U. T. w.),	270
35' and more, flaggy, cross-bedded, soft; St. Clair,	280
Often rests of the P. C. B. in (D. T. w.),	282
90' thick on Saxman's run (D. T. w.),	282
Changed to 50' of shales, $\frac{1}{2}$ m. N. of St. Clair,	283
Flaggy, twisted, full of stems (D. T. w.),	286
80'; fills the whole interval R. C.—P. C. B. (H. T. w.),	304
10' thick, 9' + P. C. B. (Sal. T. w.),	312
<i>Rider of the Pittsburg Coal Bed</i> mistaken in the old reports for the	
Redstone C. B.,	50
At Dunbar, 50' + P. C. B.,	50
At Salisbury in Somerset Co.,	54
In Union Township, Westmoreland Co.,	272
‡ Black shales, north of New Salem,	315
(7") Coal, 13' + P. C. B., Turtle Creek (F. T. w.),	329
10' + P. C. B. in the Westmoreland Shaft,	347
<i>Pittsburg Coal Bed</i> , described generally; in Salisbury Basin, 52;	
Ligonier Valley, 54; Blairsville trough, 55; in West Virginia,	
55; in Greensburg trough, 58; in Lisbon trough, 59; in Waynes-	
burg and Nineveh troughs,	61
Patches on high hills in (F. T.), 218; outliers on east side of (F. T.),	
218; rides the Saltsburg anticlinal in (S. M. T.), 219; two patches,	

south of National road in (M. T.), 219; small patches between Uniontown and New Salem, 222; area $\frac{1}{2}$ mile wide on Redstone, 223; small outliers on Salts. ant., Uniontown and McClellandtown road (G. T.), 246; area in (N. T.), 249; patches near York's run (N. T.), 252; patches in Greensburg trough, north end of (U. T. w.), 275; area in (D. T. w.), 278, 279; patches west of Greensburg, 300; on Beaver run, 314; in (Bell T. w.), 322; a patch in (W. T. w.), 325, 326; Mrs. Laird's patch, (F. T. w.), 330; patches in (Bur. & All. T. w.), 367; patches on crest of anticlinal between Monongahela and Youghiogheny rivers, 390; large patch in (Wil. T. a.), 383; three patches, Squirrel Hill (Peeb. T. a.), 385, 386; patch near Union Depot, Pittsburgh, with 35' feet cover, 386; area in (Penn T. a.), with 100' cover, 387; patches in (Plum T. a.), 389; and in (F. T. w.),	328
<i>Outcrop crosses</i> Saltsburg anticlinal on Cheat river at elevation of 1150' + tide,	16
Reaches further north in the Lisbon synclinal than in the Blairsville synclinal,	21
<i>Outcrop traced</i> through (N. U. T.) north of Lemont furnace, 176, 177; from Liberty round to Broad Ford, (D. T. & c.), 177; through (B. T.), 194; through (T. T.), 198; across Jennings's run, 222; west outcrop traced in Mount Pleasant township, 256; in (E. H. T. w.), 265; both out-crops through (U. T. w.), 269; (D. T. w.), 286; (H. T. w.), 293, 294, 295; across N. W. end of (H. T. W.), 300, 301; through (Sal. T. w.), Greensburg basin, 311, 312; Lisbon basin, 313; into Bell. & Loy. T. T., 314, 315; south-east outcrop through Loy. T., 321, 322; in (P. T. w.), 331, 332, 333; (N. H. T. w.), 338; (Sew. T. w.), 351; double outcrop in (Sew. T. w.), on Yough. R., 352; east outcrop traced in (S. H. T. w.), 354; in (Ros. T. w.), on Monongahela river 360; through (E. T. a.), 373; (Wil. T. a.), 384; (P. T. a.),	388
<i>Pittsburg Coal bed described</i> at Sturgess', Morgantown,	134
On Brooks' farm, Cheat river,	135
In (S. U. T.) on Redstone old workings,	156
In (N. U. T.) on Jennings's run, 162; at Monroe, 164; on Shute's run, 167; at Lemont Furnace,	169
In (D. T.) at East Liberty, 177; at Braddock's Station, 179; at Connellsville, 191; along Mt. Pleasant branch railway (see Coke Report L),	199
In (P. T.) above mouth of Jacob's creek, 203; on Browneller's run,	203
In (J. T.) at Lyons mill, 210; along Monong.,	213
In (M. T.) strikes Redstone water, Sharpless' mill,	224
In (R. T.) sinks into Redstone creek 1 m. above Cook's mills, 227; 120' below water level at Cook's mills, 227; comes up out of Redstone above Lyon's mills, 227; along Dunlap's Cr.,	230, 232
On Monongahela River below Brownsville,	235
In (L. T.) on Dunlap's Cr. from Millsborough to below Frederick, 237; comes out of Monongahela River near mouth of Ten Mile, run 238; at Rush run (40' below river), 238; at Lock 5 (15' below river),	238
In (G. T.) on Cat's run, 241; rises from Brown's run near forks,	243, 244

	Page.
In (N. T.) at New Geneva 300' + low water, 249; in ridge road from Geneva to Smithfield, 252; on crest of the anticlinal, 253; on Jacob's Cr., 254; at mouth of Fred's run,	255
In (E. H. T. w.) south of Tarr's Station, on P. R. R., 266; mined about Latrobe, 270; in shaft at Loyalhanna Station,	281
In (P. T. w.) mines east of New Derry, 283; on Stoney run,	284
At Georges' Station on the Pa. R. R.,	299
In (H. T. w.) on road from Adamsburg to Middleburg, 302; south-east corner,	303
In (Loy. T. w.) on Shaffer's run,	323
In (Sal. T. w.) passes into (F. T. w.),	328
In (P. T. w.) on Lyon's run, 332; reported 15½ feet thick, in boring at Manor Ch.,	336
In (N. H. T. w.) sinks into Long's run,	343
In Youghiogheny shaft south of Irwin,	344
In (S. H. T. w.) 11' 1" thick at Smith's Station,	355
On Penna. R. R. rises a little above mouth of Sew. Cr.,	356, 357
In (E. T. a.) once mined at Buena Vista, 375; goes under at forks of run, 376; at 1½ m. back from Elizabeth on Hayden's run, 377; on Plum Cr.,	389
In (Patton T. a.),	391
<i>Structure of Pittsburg Coal Bed.</i> Thins northward,	56
Yields a block coal near Brownsville,	61
Changes structure going from the Lisbon trough over into the Blairsville trough,	63
Originally deposited under different conditions,	63
Coked at Oliphant's furnace and elsewhere, see Coke Report L,	146, 147
Structure clearly shown at H. Miller's (M. T.),	221
Exceptionally thin bed at Turtle Cr. Station,	332
<i>Benchs and sections of the P. C. B.,</i>	56
Three benches in Ligonier Valley described,	54, 55
Benchs vary in different parts of same basin,	55
In Greensburg trough, 58; Lisbon trough,	59
Six benches with thin persistent partings and roof bench wanting (S. U. T.),	156
Six benches at Newcomer's (T. T.),	198
In (H. T. w.), 299; numerous, 300; at Garlow's (P. T. w.),	334
Not recognizable, Hunter's mine (Bur. T. w.),	368
Normal again, Wallace pit, Pucketta Cr.,	369
<i>Sections of Pittsburg Coal Bed, in Salisbury B.,</i>	53
At Brook's farm, Cheat river, <i>unusual</i> ,	135
At Norris cross-roads, Springhill T.,	136
In George's T. near Smithfield, 146; Oliphant's,	147
On National road, 151; east of Uniontown,	152, 153
In (S. U. T.), 157; Lemont Fur., 170; Connellsville,	191
In (R. T.) ½ m. S. of Pennsville,	195
In (T. T.), 197; Kiester's mill, 198; Jackson's,	199
In (P. T.) Strekel Hollow, near Perryopolis, 202; on Crabapple, 203; mouth of Browneller's run, 205; forks of Little Redstone,	207
In (W. T.) at Fayette city,	208
In (J. T.) at Lyon's mill, Red. Cr., 210; Litt. Red. Cr.,	211

	Page.
In (F. T.) on Crabapple, 214; east side of T.,	218
In (M. T.) at Bral's mines, 219; east of New Salem, 220; on Red-stone Creek,	223
In (B. T.) Dunlap's Cr., 232; Wood's, Brownsville,	234
In (L. T.) on Monongahela R. below Ten M. run,	238
In (G. T.) at Masonton, 241, 242; north fork of Brown's run, 244; south of Brown's run, 244; high hills at McClellandtown,	246
In (N. T.) Core's mine, 253; mouth of Fred's run,	255
At Mt. Pleasant, 256, 257; in (E. H. T. w.) 12' 8'',	266
South of Bethany, bed 12' thick,	267
In (U. T. w.) Beatty's Station, 270; at Kehoe's (10' 10''), 271; at Gallagher's, much split up,	272
In (D. T. w.) on Saxman's run, 281, 282; on the Conemaugh at Blairsville, 283; on Stoney run, 285; on Lonsdon's run, 285; south of the Conemaugh,	287
In (H. T. w.) at Greensburg, 297, 298; on road to Pleasant Unity (12' 4'') much split up, 298, 299; at mines west of Greensburg, full, 299, 300; at Penn Station, 301; at Brisbin's on Greensburg road, 302; east of Madison,	302
In (Salem T.) 1 m. W. of New Alexandria, 312; on west outcrop (11' 2'), 312; at New Salem (6' 5''), 313; at Stout's, 314; on the edge of Bell T. (9' 9'' + 10' 7''),	315
At the mines of the Saltzburg Coal Co. (10'),	322
In (W. T. w.) on N. outcrop (6' 3''),	326
In (F. T. w.) (11' 10''), 328; at Stiger's (7' 8''), 329; at Kister's (12'),	330
In (P. T. w.) at Rose's (11'), 331, 332; Westmoreland and Penn Gas Co. mines, 333; Boquette (9' 8''),	335
In (N. H. T. w.) in Coal Hollow (14' 3''), 338, 339; at Larimer (9' 7''), 339; west of Larimer at Keys (13', 16''), 343; shaft of Westmoreland Coal Co. Fig. 47,	346
In (Sew. T. w.) at Bell's mills (9' 11''), 351; at Sewickley Station, Pa. R. R. (10' 10''),	353
In (S. H. T. w.) on Sewickley Cr. (12' 3''),	354, 355
In (Ros. T. w.) N. of W. Newton pike (11' 4''), 361, 362; at Sheplar's bank, Webster, (13' 7''), 363, 364; at county line on Yough. R. (12' 7''),	366
In (Bur. T. w.) 8' 6'', 367, 368; at Wallace pit, on Pucketta creek, (10' 5''),	368, 369
In (E. T. a.) on Howell's run (10' 7''), 373, 374; at Buena Vista, (11' 2''), 375; at head of Logan Hollow (10' 10''), 376; on Watson's run (11' 3''), 378; on Kelley's run (12'), 379; on Becket's run, Monongahela City (11' 6''),	380
In (V. T. a.) all one bench (10' to 11' 3''), 381; on ridge between Jack's and Crooked runs, (lower division 5' 7''),	382
In (Wil. T. a.) mines of N. Y. & Cl. G. C. Co. (10'),	384
At Pittsburg, lower division of the bed,	386
In (Penn T. a.) shows (8' 5'') and (10' 8''),	387
In (Pl. T. a.) on Pucketta Creek (10' 8''),	390
Partings numerous in P. C. B. on Cheat River,	185, 136
Can be studied in old Miller stripping (M. T.),	221

	Page.
Often laminated at the crop, amorphous inside,	303
In the Houseman Shaft (Ros. T. w.) described,	364
<i>Roof of the P. C. B.</i> at Ligonier, 56; coal in the roof increases northward in Fayette Co. and then decreases through Westmoreland, 56; roof coal worthless, 60; roof in 10 layers, at Dunbar, 180; 7' of black slates in (M. T.), 219; roof coal wanting on Stoney run (D. T. w.), 285; diminishes suddenly in (H. T. w.) from (5' 8") to (3"), 299; has stood for 40 years in N. Salem mines (Sal. T. w.), 314; self supporting, Bell's Mills, (Sew. T. w.),	851
<i>Upper Division of the P. C. B.</i> , top bench often bony in (U. T. w.), 271; "Breast Coal" (E. T. a.), 374; "Breast Coal" thin on Wiley's run (E. T. a.), 377; "Bearing-in bench," 203; "Bearing-in benches," double in southern part of the district,	234
<i>Brick Bench of P. C. B.</i> united to Lower bottom bench at Perryopolis, 203; columnar structure (D. T. w.), 285, 299; almost a true cannal (Sal. T. w.), 315; (6" to 8") at Shaffer's run (Loy. T. w.),	324
<i>Lower Division of P. C. B.</i> (9') on Dunlap's Creek (B. T.), 232; wonderfully regular at Larimer, 340; solid (5½'), 195; (11') in (M. T.), 219; (8') at Loyalhanna Station (D. T. w.), 281; parting in it which vanishes on the Loyalhanna,	286
Level Dip, Down-throw, of P. C. B. See Level, &c.	
LOWER BARREN MEASURES.—General Sections.	
Sections necessarily fragmentary,	70
Sections in W. Va., 8 miles above New Geneva,	72
At Springhill Fur., 141; at New Geneva,	249, 250
Up Cove run, from Lemont Fur. (N. U. T.),	171
On Dunbar Creek,	182
On Yough. River, ¼ m. from Dawson Station,	199
In Tyrone T., compared with Layton Station (P. T.),	206
In (U. T. w.), east from Georges Station. Fig. 32,	274
In (H. T. w.), at Georges Station. Fig. 41, P. R. R.,	304
In (U. T. w.), west from Beatty Station. Fig. 33,	275
Very unsatisfactory below Blairsville,	287
At Saltsburg, on the Conemaugh,	318
In (F. T. w.), no general section possible,	328
East of Penn Station, ¾ mile,	336
In (P. T. w.), at Grapeville Station,	337
West of Irwin, 425' down from P. C. B. Fig. 48,	348
On Monongahela. See Rep. of Prog. K.,	378
In (V. T. a.), on P. R. R., to 75' of Black Foss. L.,	383
On Youghiogheny R. down to Green Cr. L.,	383
At Pittsburg down to 50'—Green Cr. L.,	385
In (Penn. T. a.) down to 150'—Green Cr. L.,	388
<i>Lower Barren Measures</i> , good grazing soil,	6
On Chestnut Ridge, 8; in Hutchinson Mill boring 466' ±, 158; in (W. T. w.) shales, 326; in (Bur. T. w.) 500' below P. C. B. at mill on Pucketta Creek,	368
<i>Little Pittsburg Coal Bed</i> , 66; near Smithfield (Georges T.), 145; 25' —P. C. B. on Dunbar Cr., 183; (10") 20'—P. C. B., Georges Station, 304; not seen at Greensburg, 305; in limestone under P. O. B.,	66

	Page.
<i>Pittsburg Limestone</i> , under P. C. B.,	66, 67
(2' to 4') 15'—P. C. B. west of Irwin, 348; (15') coarse; floor of P. C. B., under it 6' coal at Larimer, 340; floor of P. C. B. on Yough. (N. H. T. w.), 349; 1'—P. C. B. Logan's hollow (E. T. a.), . . .	376
<i>Connellsville Sandstone</i> , No. 11 of Section of Barren Measures, described; areas,	66
Cliffs of Conn. SS. on Dunbar Creek, 183; not conglomerate, 192; 80'—P. C. B. at Connellsville, 192; on S. W. Pa. R. R. (B. T.), 195; on Monongahela (N. T.), 251; at Bandstown (D. T. w.), 284; (85') thick, 59'—P. C. B., west of Irwin, 349; persistent at 70'—P. C. B. in (Wil. T. a.), 386; around Pittsburg, seldom a building stone,	387
<i>Limestone</i> , yellow, over Morgantown SS. Yough. (P. T.),	206
<i>Morgantown Sandstone</i> =Upper Conemaugh SS.,	320
Persistent and well defined horizon, 66; character and area, 67; readily mistaken for Mahoning SS.,	67
(180'±) — P. C. B., 157; cliffs on Dunbar Cr. cross-bedded and honeycombed, 183; bluffs on Youghiogheny, $\frac{3}{4}$ m. above Weisell's run (P. T.), 206; (?) 40' above Green Crinoidal Limestone at Grapeville (H. T. w.), 306; (35') thick, massive, on Beaver run (Sal. T. w.), 316; in (Loy. T. w.), 317; very massive opposite Saltzburg, 317; <i>double</i> , upper and lower, on the Conemaugh, (see Sec., Fig. 44), 318, 320; (50') thick, 144' to 194'—P. C. B. west of Irwin, 349; on Monongahela River at Webster (Ros. T. w.), 367; flaggy, but persistent on the Youghiogheny (V. T. a.), hard and good on the Monongahela at Port Perry, 383; around Pittsburg seldom good for building stone,	387
<i>Elk Lick Group</i> .	
Coal next but one below P. C. B. (No. 9, of Sec.),	66
<i>Limestones</i> 74' and 90'—P. C. B. at Greensburg,	304
98' and 107'—P. C. B. at George's Station,	305
(1') 94'—P. C. B. west of Irwin,	349
Local (1' to 4') 130'—P. C. B. west of Irwin,	349
<i>Berlin Group of Somerset Report HHH</i> .	
<i>Barton Group</i> , consists of Morgantown SS., Barton C. B. and Crinoidal Limestone, 66; described as Nos. 15 to 19, of section, . . .	67
Section of these measures in (Sal. T. w.),	316
<i>Berlin (Barton) Coal Bed</i> , a persistent and well-defined horizon, 66; character and range, 67; No. 13 of the Dunbar section, 184; a few feet under the Morgantown SS. in (P. T.),	206
<i>Barton Coal Bed</i> and Limestone—(E. H. T. w.),	268
Coal (1') 198'—P. C. B. George's Sta., (U. T. w.),	276
Coal (10'') 4 miles from New Alexandria,	286
(?) $1\frac{1}{2}$ miles east of Grapeville Sta. (H. T. w.),	305
(10'') in (Sal. T. w.), 316; (4'?) Beaver run,	316
Thin in (Loy. T. w.),	317
(2" to 10'') 202'—P. C. B. Larimer R. R. cut,	349
Not seen at Pittsburg, 387; nor in Penn T.,	389
<i>Barton Limestone</i> nodular,	349
A Coarse Limestone (2') 160' below P. C. B. (Fig. 82),	276
A Coal in the interval 250' to 280' below P. C. B. George's,	276

	Page.
<i>Green Crinoidal Limestone</i> , (Green Fossiliferous Limestone of the Report of 1858; also Crinoidal Limestone) a persistent and well defined horizon; sometimes in the old Reports and in Rep. of Prog. K. 1875, confounded with the Black Foss. L.,	66, 68, 78
Seen $\frac{1}{2}$ m. from Springhill Furnace,	137
Seen opposite Lemont Furnace,	171
Seen, 184; on Youghiogheny (P. T.),	206
In Upper Middlebury (M. T.), 268; in (E. H. T. w.),	268
In (D. T. w.) 2 m. from New Alexandria,	286
In (H. T. w.) near Grapeville,	306
In (Sal. T. w.) 260'—P. C. B. Greensburg, N. Salem,	316
In (W. T. w.) south of Webster's Cross-roads,	326
In (F. T. w.) near Welsler's Cross-roads,	331
East of Penn Station,	337
In Larimer tunnel (4') 235'—P. C. B.,	349
Well seen in (V. T. a.) at Elrod's Station,	383
Very fossiliferous around Pittsburg,	387
Limestone 10' below Green Cr. L., Cove run (N. U. T.),	172
Limestone shale (1') 15'—Gr. Cr. L., 254'—P. C. B. west of Larimer Station, non-fossiliferous,	349
Coal bed under Gr. Cr. L., local in Pittsburg,	389
Coal bed 75'—Gr. Cr. L. near Springhill Furnace,	137
Coal bed (4') 75'—Gr. Cr. L. near Haydentown (Georges T.),	150
Coal bed 815' (\pm) below P. C. B. Carr's tunnel (U. T. w.),	276
Coal bed 340' (\pm) below P. C. B. (N. T.),	252
Coal bed, good, 85'—Gr. Cr. L. Cove run (N. U. T.),	172
Coal bed, 135'—Gr. Cr. L. near Springfield Furn.,	137
Coal bed, (2'), low in Bar. Measures, Dunbar Cr.,	185
<i>Sandstone of Carr's Tunnel</i> , 350' to 400'—P. C. B., and seen again on Greensburg pike, (50') thick, flaggy,	277
<i>Sandstone</i> , coarse, cong., (15') 405' to 420'—P. C. B. at Carr's tunnel (U. T. w.),	276
<i>Philson (?) Coal Bed</i> at Carr's Tun. 450'—P. C. B.,	276
<i>Black Fossiliferous Limestone</i> , (1') 472'—P. C. B. at Carr's tunnel (U. T. w.),	276, 277
Mistaken for Green Crinoidal Limestone in Report K, and 1858, 68; on Redstone Cr. above Upper Middlebury (M. T.), 224, 225; under Crow's Mill Ore Bed, 350'—P. C. B., 252; (4') sandy, with but few fossils, but black shale full of fossils, 400'—P. C. B. at Stewart's Station,	350
<i>Upper Middletown Coal Bed</i> , 550'—P. C. B. (M. T.),	225
Coal bed, poor, over Mahoning SS., R. R. cut (T. T.),	201
Coal bed (3'), over Mah. SS., Beaver run (Loy. T. w.),	324
Limestone turning to Johnstown ore, over Mah. SS.,	120
<i>Mahoning Sandstone</i> , usually included in the Lower Productive Coal Measures, 73; readily substituted for Morgantown Sandstone, 67; often double and includes a coal bed, 74; character and area, 75; 60' thick; elsewhere only 35'; 75' on Dunbar Creek; 40' in Derry and Unity; 50' on Yough.; 40' on Sewickley; 85' feet all shale on Loyalhanna and Conemaugh; 60' under the Waynesburg anticlinal,	75, 76

	Page.
Cliffs of Mah. SS., a marked feature of West Virginia, south from Morgantown,	85
Conglomerate, conspicuous, at foot of Rich Mountain in West Virginia,	85
Section of Mah. SS. on Redstone Creek,	160
(20') in (N. U. T.) on Cove run, coarse, cross-bedded, with many fine casts of <i>Lepido. obovatum</i> ,	172
Double on Dunbar Creek,	186
A conglomerate above Connellsville,	192
Fragments at Upper Middlebury on Redstone (M. T.),	224
The probable salt-bearing rock at Brownsville,	234
Yields oil also, 600'—P. C. B. Brownsville,	234
70' thick, 550'—P. C. B. Second and principal oil rock of Greene county, 235	
70' thick, 550' to 620'—P. C. B., salt well,	235
Not to be seen over E on Jacob's Creek,	265
Seen 1 m. N. from Bethany, Pa. R. R. (E. H. T. w.),	268
Rests on Coal bed E in (D. T. w.),	288
Flaggy, coarse, massive, plant-casts, Loyalhanna,	289
At mouth of Miller's run (D. T. w.),	290
400' above top of XII. Doubtful salt-well record at Paintersville, (H. T. w.),	309
Sinks westward into Sewickley Cr. $\frac{1}{2}$ m. above Waltz's Mill, (H. T. w.); rests on E,	310
Represented by shale at the mouth of Loyalh. R.,	320
12' thick on Beaver run (Loy. T. w.),	324
40'+ thick, resting on E, Sewickley Cr. (S. H. T. w.),	359
Rises from Allegheny R., 1 m. S. of Lockhart Sta.,	370
Bluffs along the Allegheny R.; often rests on E,	370
Coal Bed in the Mahoning Sandstone,	74
At Morgantown, 75, 85; on Redstone Creek, (1 $\frac{1}{2}$ ') thick, Beason's bank, (S. U. T.),	160
On Dunbar Creek,	186
Coal (2') thick, 60' above E, Pucketta Cr. (W. T. w.),	327
LOWER PRODUCTIVE COAL MEASURES described,	75
Sections obtained in the ravines of Chestnut ridge necessarily difficult and defective, 73; coals hard to identify, 74; impossible below Freeport Sandstone,	81
General section along Dunbar Creek,	186
Section made by Prof. White opposite Freeport,	370
Areas distributed over the district, 8; Chapter VII,	73
In W. Virginia, 84; in Hutchinson Mill boring (S. U. T.), 107' deep, 158; on Redstone Creek, 224; on Sewickley and Little Sewickley (H. T. w.),	306
Freeport Series, general section at mouth of Loyalhanna. Fig. 44, 319; on Sewickley Creek,	307
Upper Freeport Coal Bed E', 35' above E on Jacob's creek; and again 15' above E,	265

	Page.
<i>Upper Freeport Coal Bed E</i> , brought up by the Blairsville anticlinal, 14; does not hold less volatile matter going east, 62; character and area described, 76; variability shown by section, Fig. 7 Springhill T., 76; split and distributed through 17 feet of section, 76; double bed, 76,77; at Braeley's old mill on the Loyalhanna, 77; not brought up on the Conemaugh by the Blairsville anticlinal, 77; exposed on Redstone and all large streams north of it by the Saltsburg anticlinal, 78; on the Youghiogheny above Layton, 78; for miles on Big Sewickley, 78; double on Little Sewickley, single on the Loyalhanna and Conemaugh, 78; 4' to 8' thick on Conemaugh and Allegheny rivers, on Pinhook and Waynesburg anticlinals,	79
E very variable in West Virginia, split up and distributed through 25' (?) section on Buckhannon river; see section, Fig. 9,	86,87
E, the "Stockton Coal" at Cannelton, on Kenawha, and the only coal bed left in the Lower Productive series at the Oil Break, W. Va.,	87
E on the Parkersburg branch of B. and O. R. R.,	88
Section at Old Jones' bank, Springhill T.,	138
On Rubble's run; 16' 3" thick; partings,	138
On Black Creek, Low's bank, George's T.,	150
On National road, Lick Hollow,	158
Section on Redstone, Beeson's, (S. U. T.),	159,160
Coal of lowest bench extremely good,	160
Section in (N. U. T.), (11') south-east of Monroe,	165
On Cove run (3' 3"), 172; (6') on Dunbar Cr.,	186
Mistaken for P. C. B. White Rock Station, Connellsville,	192
On Break-neck creek (4') (B. T.),	197
Section in (T. T.), 202; in R. R. cut, Youghiogheny river,	202
630'—P. C. B., thick, in salt well, Brownsville,	235
Only bed opened on Chestnut Ridge N. of Jacob's Cr.,	260
Near Laurelville (4') (Mt. P. T. w.),	260
Section on Jacob's creek "Three-foot coal" (6' 5"),	264
On R. R. 1½ m. N. of Bethany Sta. (2' 3") (E. H. T. w.),	268
On Loyalhanna, near Braeley's mill (3' to 4'),	277
At Col. Johnson's (4') in (U. T. w.),	278
At Millwood Station (8') in (D. T. w.),	288
Sections on Miller's run, &c.,	288,289
Fat, but not fit for gas or to cooke, on Loyalhanna,	289
Lifted on Little Sewickley by Saltsburg axis,	293
Section of poor coal bed at Grapeville (H. T. w.),	306
260'—Green Crinoidal L. (10' 6") Grapeville,	306
0'—30'—65', E, D, C, ? in salt well, Sewickley Cr.,	307
Very variable at Paintersville (H. T. w.),	309
Sections at old carding-mill; a clinkery coal; over Freeport Limestone down Sewickley creek,	310
Rises at White's Station (4') from Conemaugh (Loy. T.),	319
Sections at Ford of Loyalhanna; rises below Ford,	320,321
Sinks into Loy. R. ½ m. below woolen-mill,	321
On Beaver run (Loy. T. w.),	324
Not quite brought up on Pucketta creek (W. T. w.),	326

	Page.
Section on lower Beaver run (4' 8") in (W. T. w),	327
Section on Sewickley Creek (5') in (S. H. T. w.),	359
On Jacob's creek (3' to 4') in (S. H. T. w.),	360
Rises a little below Lockhart Station, A. V. R. R.,	370
Varies from 8' above Tarentum to 10" above Chartiers,	371
<i>Coal Bed local</i> , 3' under E., Dunbar creek,	186, 187
<i>Freeport Limestone</i> wanting (?) on Redstone, and why,	78
Necessary for distinguishing E from D (D'),	78
Wanting on Dunbar creek and National road,	82
Character and extent, 79; Ferruginous, 80; variable,	88
Ends south of Staunton pike in W. Va.,	90
Always ferruginous, 122; on top, Springhill Fur.,	138
Changes to calcareous ore in Drague Hollow,	139
Turns to iron ore on Dunbar creek,	187
Mistaken for the Limestone under P. C. B.,	193
15' below E on Jacob's creek,	265
10' below E on Miller's run (D. T. w.),	289
(1') thick on S. W. Penn. R. R. (H. T. w.),	308
(1½') 12' below E, Fulton's, Sewickley Cr. (H. T. w.),	310
(3' to 5') at Saltsburg, 319; (10') on Beaver run,	325, 327
(1½') 12' below E—Sewickley Cr. (S. H. T. w.),	359
(3' to 5') 1' to 4' below E, and suddenly dividing into three bands, above Chartier's Stat., A. V. R. R.,	371
<i>Freeport Sandstone</i> ,	81
Conglomerate; 25' below E on Youghiogheny (T. T.),	202
Irregularly bedded, concretionary, cong. plants,	371
<i>Lower [Middle?] Freeport Coal Bed D [D']</i> , character and extent uncertain,	80
Mined, but poor and sulphury, on Sewickley creek,	81
Erroneously identified with E at Nuzum's mills, W. Va.,	88
Section at Kirk bank, Drague Hollow, (Sp. T.),	139
With Limestone, Dunbar creek,	187
D', 30' below E in salt well, Sewickley Cr. (H. T. w.),	307
D, 65' below E in salt well, Sewickley Cr. (H. T. w.),	307
Sections of D [D'] 4' 7" on Sewickley creek,	308
In Paintersville well (2') (H. T. w.),	309
Unknown on the Conemaugh near Saltsburg,	319
Section, Fig. 44, (3') on the Loyalhanna,	319
Irregular on the Allegheny river,	371, 372
<i>Coal Bed overlying Piedmont Sandstone</i> ,	81
<i>Piedmont Sandstone (Tionesta Sandstone?)</i> ,	82
Upper member of Great (Seral) Conglomerate, easily distinguish- able from the lower member, (No. XII); free from iron and feldspar in Fayette county; not distinguishable from Coal Meas- ure sandstones to the north of the Loyalhanna,	83
Lost among the sandstones north of B. and O. R. R.,	89
In Springhill T. 10' thick in one layer; thicker in George's and S. Union Tl., 30; flaggy north of the National road, 82, and,	140
110' below E in hollow of Chestnut Ridge (N. U. T.),	173
Carefully described, 1 m. E. of Lemont Furnace,	173
30' thick at Sand-works on Youghiogheny,	193

	Page.
<i>Mount Savage Coal Bed</i> (A?) Section, Fig. 8,	83, 84
Section in (N. U. T.),	167
Parted by iron ore, 83; by sand rock in W. Virginia,	89
"Stratford Coal Bed" on Cheat River,	83
8' thick (reported) in gorges of (S. U. T.),	83
9' 2" (measured) in (N. U. T.), 84; (1' 6") Dunbar,	84
Section on Cheat River; in Springhill T.,	140
In Lick Hollow (7'?) in (N. R.),	158
On Redstone Creek " (7' to 12') " in (S. U. T.),	160
Section at Coolspring Fur. (8½') (N. U. T.),	167
Deserted mine, head of Chestnut Hollow,	173
Absent? on Mount's creek,	196
Near Laurelville (8') in (Mt. P. T. w.),	261
<i>Pottsville (Seral) Conglomerate</i> , No. XII,	8
Low on the mountain south of Youghiogheny,	12
40' to 70' thick on Chestnut Ridge; 100' on Cheat river; 100' Tygart's Valley gap; 350' on Decker's creek; 600' in Rich Mountain; 1,200' on the great Kanawha river; 30' to 800' in E. Kentucky,	91, 92, 94
Coarser and more ferruginous than Piedmont Sandstone, never flaggy, 83; fine-grained in the gaps, 92, 193; quartzite at base, 92; all conglomerate on the Staunton pike, W. Va.; only sandstone and 9 coal beds on Kanawha above Gauley,	93
Has furnished (?) material for conglomerate sandstones of the Barren Measures on Dunbar Cr.,	185
Above Dunbar Furnace, 187; triple on Mount's Cr.,	196
Near Laurelville (50' thick) in (Mt. P. T. w.),	260
On Jacob's creek, 262; on Miller's run (D. T. w.),	290
In Loyalhanna gap,	290
"Forty foot rock" of the salt borers on Sewickley,	307
400' below Mahoning SS. in Paintersville well (357' down), 73' thick, called "Eighty-foot rock,"	309
<i>Coal Bed</i> (Sharon?) in base of XII, on Mount's creek,	106
<i>Coal Bed</i> between middle and lower XII, persistent,	196
<i>Mauch Chunk (Umbral) Red Shale</i> , No. XI,	8, 12
In W. Virginia 0', 50', 200', 1,250', thick,	101
In Loyalhanna gap 20' + 35' + 15' + 8' = 78',	291
Red shale cuts off sandstone,	189
Conglomerate Sandstone of XI (3' 6" thick) contains angular pieces of the underlying limestone in Connellsville Gap,	292
Sandstone 478' below E in W. Va. holds 4 coal beds,	90
<i>Coal Beds</i> of No. XI, under the Conglomerate,	97
In Kentucky, Tennessee, and in the district,	101, 103
Coal bed, 15' under XII, on Shute's run (N. U. T.),	168
Absent from Dunbar Creek,	188
2½' thick on Jacob's creek,	261
<i>Limestones</i> of No. XI described, 93; appear on the arch in Jacob's Creek gap,	100
Upper part of the mass rich in fossils; increases southwards to 30', 100; makes white lime in George's T.,	151

	Page.
Lower part 100' thick on Cheat river, 105' on Decker's cr., 700' in Rich Mountain, 822' in Pocohontas Co., W. Virginia,	101, 102
550' below E on the Kanawha River,	89
47' thick in Hutchinson Mill boring (S. U. T.),	158
300' to 400' above X at Turkey Nest (N. U. T.),	166
At Coolspring Furnace, described (N. U. T.),	169
In gap of Youghiogheny (D. T.) described,	194
175' below XII, on Jacob's creek, described,	262
100' and 120' below XII, two beds, fossiliferous, (2') thick, 60' and 40' above silicious limestone, in Loyalhanna gap,	291
Blue silicious L. (15') thick, 160' below XII, in Loyalhanna gap; weathers into loose sand,	292
40' thick, very silicious in Conemaugh gap,	292
<i>Pocono (Vespertine) Sandstone</i> , No. X described,	8, 105
Passes downward into No. IX; Loyalhanna gap,	107
Conglomerate layers, base of X, National road,	106, 107
On Chestnut Ridge (Laurel Hill) S. of Conemaugh,	108
Fine-grained sandstone resembling limestone,	108
Passes into Lower Mountain L. in W. Virginia,	108
Same as Waverly Sandstone of the Ohio reports,	108
At the Turkey Nest in (N. U. T.),	166
1,200' of X and IX exposed in Youghiogheny Gap,	190
Makes the crest of Chestnut Ridge at the Loyalhanna,	292
.443' feet of X measured in Conemaugh Gap (Fig. 39),	292
Conglomerate layers of X at the Packsaddle,	292
20' of SS. and cong. X (IX?) 568' below L. of XI,	293
<i>Coal Bed in X</i> reported on Redstone Creek,	107, 108
<i>Limestone in X</i> not seen in Youghiogheny gap,	190
Red shales below the base of X,	107
<i>Catskill Red Sandstone</i> , No. IX, Conemaugh gap,	107
Greyish red shales of IX (?) Conemaugh gap,	293
<i>Limestone</i> at the base of IX in boring, National R.,	105

PART III.—Index to the Iron Ores.

IRON ORES OF THE DISTRICT (K K) classified,	110
ORES OF THE UPPER PRODUCTIVE COAL MEASURES.	
Over the Washington Coal Bed,	27
Under the Little Washing. C. B., Brown's run,	245
In Waynesburg Coal Bed shales,	33
Nodules with plants in Waynesburg C. B.	228
PITTSBURG IRON ORE GROUP; <i>Big Coal group</i> on Cheat, 110;	
comparative section,	111
Section of ore beds below New Geneva,	115
Thins out N. of Dunbar, 116; in Greensburg trough,	117
In W. Va., Scott's run; persistent; supply large,	118
Section at Oliphants, 147; at Fairchance,	149
At Monroe, 164; at Lemont Furnace,	170
At Frost's station (N. U. T.), 176; Braddock's Sta.,	181
Vanish at Henderson's, 182; gone at Connellsville,	191
Layers of ore occurring in cannel slate,	181

	Page.
A 27 per cent. ore, looks like a brown mud,	181
Ore does not follow the swells in P. C. B. clay,	181
Ore occurs in a horseback on the Paull farm,	181
Nodular ore at Brownsville, under P. C. B.,	234
Ore overlies limestone, under P. C. B. (G. T.),	244
Black-band ore under P. C. B. Dunlap's Cr.,	247
Ore on Little Redstone, 208; mouth of Fred's run,	255
Worthless at Greensburg,	335
<i>Blue Lump</i> , 111; New Geneva, 112; Cat's run,	112
Not persistent, and perhaps of later origin,	118
Mined for Springfield F., 136, 137; at Oliphant's,	147
In (S. U. T.) 157; at Monroe, 164; Lemont F.,	170
Great abundance and good from N. Geneva to Cat's run,	249
<i>Condemned Flag ore</i> ,	114
<i>Big Bottom Ore (of the Pittsburg Group)</i> ,	111
At Fairchance, 142; Oliphant's, 148; Monroe, 164; Lemont Fur-	
nace,	170, 171
<i>Red Flag Ore</i> ; at Oliphant's Furnace,	111, 148
<i>Yellow Flag Ore</i> ; at Oliphant's Furnace,	111, 148
At Monroe (N. U. T.),	164
ORES IN THE BARREN MEASURES.	
Nos. 2 and 26 of the General Section,	69
Ores in the upper part of the Barren Measures,	119
Over the Connellsville Sandstone,	251
140' below the P. C. B. on York's run (N. T.),	252
On the Morgantown Sandstone, Saltzburg, local,	318
350' below the P. C. B. Crow's mill (N. T.),	251
450' below the P. C. B. lean, (2' beneath a coal bed),	276
470' below P. C. B., lean, Carr's tunnel,	276
<i>Johnstown (Snake Den) Ore</i> , over Mahoning SS.,	72
On Cheat, 110, 119; Mount Pleasant Fur.,	120, 121
On Rubble's run (S. T.), 138; S. E. of Monroe,	165
On Cove run, 172; a clay, on Dunbar Cr.,	186
On Jacob's Cr., 265; at White's Sta., Saltzburg,	318
Same as "Fairchance Ore," 149; "Hardman's Ore,"	121
On Redstone cr. (S. U. T.), 160; limestone ore on cove,	120
"Haine's Ore" at Pridevale, W. Va.,	121
ORES OF THE LOWER PRODUCTIVE COAL MEASURES.	
<i>Freeport Ore Group (Norris Group</i> , on Cheat), 110; confined to Fay-	
ette County and W. Virginia,	121
At Springhill, under Mahoning Sandstone,	122
<i>Coal Bank Ore</i> on Jacob's Cr. = Freeport L.,	122
Ore on Dunbar Creek, place of Freeport L.,	187
Ores in (S. H. T. w.) described in Coke Report,	360
Ore in nest of clay 15' below Kittanning C. B.,	140
<i>Mt. Savage Ore Group</i> , overlying No. XII,	110, 123
<i>Stratford ore group</i> of W. B. Rogers, on Cheat,	110, 124
On Mount's creek, 195; in No. XII,	196
<i>Carr's ore</i> , with Mt. Savage Coal, on Cheat,	140
<i>Jude ore</i> of Coolspring Furnace (N. U. T.),	124
<i>Mahan ore</i> on Redstone Cr. (10'-A.),	124, 160

	Page.
Ore interleaved between two benches of A.,	83
<i>Ores of XI; Umbra! Ore group; Martin group</i> on Cheat river, 110; section, 125; runs out northwards in Mt. Pleasant T., and south- wards beyond Cheat,	125
Section on Fairchance lands; head of Drague Hollow,	142
At Fairchance Furnace, Georges T.,	150
Dunbar Furnace, 187; Hennessee hill mines,	188
Irishtown hill mines and section,	188, 189
Once mined on north bank of Youghiogheny,	193
Mount's Cr. section, 195; Jacob's Cr.,	261, 263
Nearly wanting in Loyalhanna gap,	290
Bog ores, along the outcrops on Jacob's creek,	262
Hematite at Pridevale not identified in Pa.,	132, 291
Flag ore of XI local at Dunbar,	129
<i>Honeycomb Ores (Big and Little) of XI</i> ,	125
At Lemont, 126, 127; Fairchance; roasted,	142
Mines at head of tramway, Lemont,	174
With coal, 168; at Dunbar,	188
<i>Kidney Ore of XI (Pin Ore of Vernon)</i> ,	125, 127, 128
Showing the fucoid casts (?) at Smiley's,	174, 175
Not Kidney at Lemont mines,	174, 175
On Mount's Cr., 196; no horsebacks,	197
<i>Big Bottom Ore of XI</i> , thickens near horse,	125, 129
At Turkey Nest (N. U. T.); 165, 167; Shute's run,	168
80' below XII, 169; 75' below XII, Smiley's,	175
At Dunbar, 188, 190; Mount's Cr., 196; (6'),	263
<i>Red Belt Ore of XI</i> confined to W. Virginia,	125, 132

PART IV.—Index of Structure, &c.

ANTICLINALS OF THE DISTRICT (KK) described,	10
<i>Laurel Hill Anticlinal</i> = Kingwood Axis at Rogers,	10
<i>Tygart's Valley Anticlinal</i> in W. Virginia,	85
<i>Chestnut Ridge Anticlinal</i> described, 10; side throw to the east, 11; rises southward from 1,250' above tide to 2,400', 13; may fork and become the <i>Preston Anticlinal</i> of W. Va., 18; crosses the Yough. 1½ m. W. of Indian Cr. Station, 191; on Jacob's creek, 263; crosses Pa. R. R. in gap of Conemaugh near 298th M. P.,	293
<i>Blairsville Anticlinal</i> , described and traced, 13; dies out before reach- ing Sewickley creek, 14; strongest where it crosses Loyalhanna, 14; carries Huckleberry Ridge, 14; disappears in (U. T. w.), 268, 269; crosses Pa. R. R. at Carr's Tunnel (U. T. w.), 275; traced through (D. T. w.),	278
<i>Saltsburg Anticlinal</i> described and traced, 14; side throw near Little Sewickley, 15; a second time south of the Yough.; a third time north of the National road, 15; carries Brush Ridge in West- moreland, and Grapeville Ridge, 16; topography marked by high hills, 16; levels and dips, 16; rises northward from 1,150' to 1,600',	16

	Page.
Traced through (S. T.), 133; through (T. T.) on Yough., 197, 202; through (F. T.), 213; through (M. T.), 218; thrown, 223; crosses Redstone below Wood's distillery (M. T.), 224; through (G. T.), 241; across (N. T.), 248, 249, 253; replaces the Greensburg Synclinal in (H. T. w.), 293; traced through (Sew. T. w.), 311; across (L. and B. T. w.), 316, 317; and across (S. H. T. w.),	354
<i>Waynesburg Anticlinal</i> described and traced, 17; rising towards the north,	17
<i>Roaring Run Anticlinal</i> (Waynesburg Ant.) traced through (W. T. w.), 325; through (F. T. w.), 327; through (P. T. w.), 331; crosses Pa. R. R. west of Carpenter's Station, 349; shifted east in (Sew. T. w.), 350; and traced through (Rost. T. w.),	360
<i>Pinhook Anticlinal</i> , described and traced, 17; rises northward, 18; traced through (Bur. and All. T. w.), 367; through (V. T. a.), 381; through (Wil. T. a.),	383
<i>Peter's Creek Anticlinal</i> of report K, nothing but the Pinhook Anticlinal shifted eastward,	18
<i>Washington Anticlinal</i> , gentle, crosses the river a little below Birmingham, opposite Pittsburg,	385
SUB-ANTICLINAL IN THE SYNCLINALS more or less local	23
<i>Bolivar Sub-anticlinal</i> in the Ligonier Valley,	12, 18
<i>Preston Axis</i> subdivides the Ligonier Synclinal,	18
<i>Mount's Creek Anticlinal</i> ,	11
Rolls in (D. T.), 12; local roll on the Yough. R. between Broadford and Jackson mines, 199; on Redstone, with swells of the coal bed, 210; slight and local roll in (R. T.), 230; local roll at salt well, Brownsville, 235; local roll in (L. T.) across Dunlap's creek, 1 mile from Yough. river, 237; local rolls in P. C. B. at Greensburg, 298; local anticlinal in P. C. B., Larimer, 310; local anticlinal between Moss Side and Stewart's Station P. R. R.,	350
<i>Bullskin Anticlinal</i> ,	194
SYNCLINALS OF THE DISTRICT (KK). Difficult to find their central lines, 23; made up of smaller troughs, 23; drainage difficult, 23; shafting in center line often disappointing,	23
<i>Ligonier Valley Synclinal</i> , Second Bituminous Coal Basin of W. Pennsylvania,	18
<i>Blairsville-Connellsville Synclinal</i> —Third Bit. C. Basin, 19; levels of its hills above the Ocean, 20; holds U. B. C. Measures, 26; in (G. T.), 143; traced through (S. Un. T.), 151; why deep south of Connellsville,	176
<i>Greensburg Synclinal</i> , described and traced, 20; crosses Conemaugh at Horse-Shoe Bend, 20; rises northward, 20; holds no U. Barren Measures, 26; crosses Pa. R. R., 200 yds. E. of Greensburg tunnel, 293; rises southward and vanishes in (H. T. w.), 293; traced through (Sal. T. w.),	311

	Page.
<i>Lisbon-Irwin Synclinal</i> holds all the Washington Group of U. Barren Measures, 8, 9, 26; described and traced, 20; rises northward from 500' to 1,000', 21; occupies (P. T.), 202; occupies all (Wash. T.), 207; deflected 2 miles in (J. T.), 209; course very obscure, 209; occupies all (J. T.), 210; traced through (R. T.), 225; crosses National road, near Colley's house (R. T.), 226; traced in (R. T.), 232; crosses Middle Run (G. T.), 241; traced in (F. T. w.), 327, 328; across (P. T. w.), 331; crosses Pa. R. R. just west of Manor Station (N. H. T. w.), 337; is shifted eastward in (Sew. T. w.), 350; traced in (S. H. T. w.), 354; through (Ros. T. w.),	360
<i>Waynesburg Synclinal</i> described and traced, 22; rises northward from 740' to 1,000', 22; holds no U. Barren Measures, 26; traced in (Bur. and All. T. w.), 367; crosses Pucketta Creek at Mill (Bur. T. w.), 368; in (E. T. a.), 373; crosses in (Pl. T. a.),	389
<i>Nineveh Synclinal</i> described, 22; crosses at Pittsburg, near Six-mile Ferry,	385
<i>Harrison City synclinal</i> in (P. T. w.),	335
<i>Local Synclinal</i> near Larimer Station,	349
<i>Strength of Dip recorded in this Volume at various points</i> :—In Cone- maugh gap, 13; on the flank of Chestnut Ridge, 13; 1° on both sides of Waynesburg Ant., 17; dip variable as a general rule, 23; dip of E, 30° on Black Cr. (G. T.), 150; of P. C. B., 3° to 4°, on Redstone (S. U. T.), 156; of P. C. B. 500' per mile, Jen- ning's run (N. U. T.), 162; steep at Turkey Nest (N. U. T.), 166; steep in Coal A, 167; of XII, 173; 20' to the mile, on Yough. R. in (P. T.) above Weitsel's run, 205; 4°, below Weit- sel's run, 205; 320' per mile in P. C. B. New Salem, 220; 350' per mile in P. C. B. gangway (M. T.), 222; rapid in (R. T.), 225; 80' per mile to S. E. along the axis of Waynesburg Synclinal in (L. T.), 238; rapid on anticlinal to W. of S. in (N. T.), 253; 5° W. N. W. in P. C. B. near Youngstown (U. T. w.), 269; sharp at Morgan & Co.'s (U. T. w.), 270; locally reversed in R. R. cut 1 m. from Latrobe (U. T. w.), 270; 90' per mile in P. C. B. indi- rect = 2° direct (D. T. w.), 281; 2° close to the synclinal axis at Loyalhauna Station (D. T. w.), 281; rapid in Cone- maugh gap, 288; 12° in rocks of X in gap, 293; 17° for 50 yards in P. C. B. gangway, Greensburg mines, (H. T. w.), 298; 270' per mile W. N. W. in (F. T. w.), 330; 200' in 2 miles in (P. T. w.), 334; 95' in $\frac{1}{2}$ of a mile, P. C. B. in (Ros. T. w.), 364, dip of Coal bed E above Chartiers more rapid than below, on the Alle- gheny river,	370
VARIATIONS AND IRREGULARITIES IN COAL MEASURES.	
<i>1. Of original Deposit. 2. From movement and pressure.</i>	
Law of variation hidden from lack of sections,	72
Variations in Washington C. B.,	28
In Great Limestone, abrupt; at its N. edge,	40
From 1½' in Westmoreland to 50' in Fayette;	280
In Westmoreland shaft, &c., 7½', 12', 15', 28',	347
In Sewickley C. B., 44; very curious in (F. T.),	216
In Redstone C. B., flagrant, 346; at Greensburg,	297

	Page.
In Pittsburg C. B., very limited, 52; 8' to 11' in a few rods, 135;	
lower bench 6' to 9' between E. Liberty and New Alexandria,	
177; in its roof, great (Sal. T. w.), 812; in roof, remarkable, Ir-	
win and Larimer mines, 339; in (V. T. a.), 382; in (Penn T. a.), . . .	387
In the interval between P. C. B. and its rider 10' to 50',	50
Interval, P. C. B. — R. C. B., 10' to 116',	49
Interval, P. C. B. — Great L., 120' to 170' in 2½m,	283
In Pittsburg Sandstone, 90' to 50' of shale,	283
Strikingly exhibited at Beatty's,	271
Variations in the Barren Measures abrupt and frequent,	66
Below the Green Crinoidal L. excessive,	68
Of the height of column discussed,	70, 276, 328
Of the upper part of George's Station Sect. (Figs. 41, 42),	304
In the number and thickness of their limestones,	72
In the Morgantown Sandstone; shale at Saltzburg,	317
Variations in the Lower Productive Coal Measure Sections,	74
In Coal Bed E throughout the district KK, 76; very great in W.	
Virginia, 86, 142; great at Paintersville (H. T. w.), 309; excess-	
ive on account of pressure of Mahoning Sandstone 3',	370
In Freeport Limestone above Chartiers, A. V. R. R.,	371
In Coal Bed D (D'?), great on S. W. Penn. R. R. (H. T. w.),	309
In Coal Bed A, excessive,	83
Variations in the Iron Ore Beds, great and numerous,	112, 113, 114
Over the Mahoning SS., 120; in ore beds,	127
In Big Bottom of XI, from carbonate to silicate,	130
In ores of XI under the name of "Misses,"	188, 196
Variations in Pocono Sandstone, No. X, sporadic shales,	106
Variations in under clays from plastic to compact	138
<i>Irregular or cross stratification</i> , often curious, as,	201
Characteristic of the Pocono Sandstone, No. X,	106, 292
Remarkable in sandstone over the Waynesburg C. B.,	154
Also in the sandstone lying 325' above W. Newton,	356
<i>Horsebacks showing irregular deposit after erosion.</i>	
In Waynesburg C. B., Dunlap's Cr. carefully described,	231
In Sewickley C. B.,	156
In Redstone C. B., characteristic of the bed,	48, 352
Descends from the roof, 204; bad on Little Redstone,	209
Meet from the roof and from the floor (pressure?),	358
In Pittsburg C. B., sandstone horses in the roof,	61
In the main clay (H. T. w.), 298; in coal at Foster's (P. T. w.),	
333; at Larimer's, 341; large sandstone horses at Larimer's and	
Irwin's carefully described, 342; sandstone horses wanting in	
the area south of Irwin, but replaced by abundant clay veins,	
344; curls the bed down to the Bearing-in Bench at Sewickley	
Station (Pressure?), 353; rare in the bed in (V. T. a.),	381
In coal bed E horsebacks are seldom seen,	79
In the ore beds of XI horsebacks of structureless clay, called	
"Wants" and "Misses," are numerous and abrupt, and thicken	
the ore near and around them (pressure?),	129, 130, 189, 190, 196
Erosion of the Waynesburg Limestone before the deposit of the overly-	
ing sandstone,	35

	Page.
Erosion of the Great Limestone, soon after its deposit, to receive the incumbent Sandstone,	303
Erosion of the Sandstone, in its turn, to receive shale, at Penn Station, P. R. R., described in full,	303
Erosion of Sewickley C. B., previous to deposit of its sandstone roof rock,	42
Erosion of Redstone C. B. (80' + P. C. B.) and the preservation of its fragments in sandstone 120' + P. C. B.,	304
Erosion of Pittsburg C. B., top bench, 58; in (F. T.) 214; in (N. T.) 252; unconformability of the bottom bench on its under clay,	58
Erosion producing non-conformability in Bar. Meas.,	201
Erosion of Mountain Limestone (XI) proven by fragments of it found in the 2½ foot layer of coarse sandstone overlying it in Cone- maugh gap,	292
<i>Pressure, vertical or lateral, the cause of irregularities,</i>	<i>271</i>
Proved by contortions in roof shales and top bench,	282
Proved by faults and clay-veins in Wallace mine,	369
In Logan Hollow, &c.,	275, 276, 377
<i>Faults of 3' in coal-shale E. of Stewart's Station,</i>	<i>350</i>
In clay-vein, side-throw of 4',	369
In one bench of P. C. B. down-throw of 3' local,	369
In P. C. B. throw of 10", produced by clay-vein,	375
In P. C. B. throw of 2' on one side, by clay-vein,	377
Waved, huminocky condition of Sewickley C. B.,	216
Swells in underclay of P. C. B., 58; at Dunbar,	180
In M. T.) 223; in (B. T.), 232; in (E. H. T. w.),	266
Curves of pressure common to P. C. B. and its roof shales,	271
Curves in floor of P. C. B. <i>sometimes</i> at expense of shale,	271
Swells in P. C. B. not a serious impediment,	273
Roll in P. C. B., Greensburg mines (H. T. w.),	298
Swells of clay-parting, slight, in P. C. B. (Sal. T. w.),	313
Swells in main clay-parting cuts top bench, Sew Cr.,	355
Swells of P. C. B. main clay-parting, frequent but slight,	388
Swells in the roof of E.,	321
Swell of clay confined to one side of a fault, coal E.,	377
Folds, elliptical, surrounded by swamps,	341
Roll of underclay, peaking up into a branching clay-vein,	375
Waves of clay out out Coal Bed A in W. Va.,	89
Crups of clay in the floor of XI Ore Bed,	197
Swell of red shale (XI) cutting off the SS. under ore	189
<i>Swamps</i> habitual to all flat coal measures,	<i>23</i>
Large in P. C. B. at Penn's Station,	301
Surround two folds in Larimer mines,	341
Swamp of the lower bench of P. C. B. just where a horseback cuts off all the upper benches,	343
Swamp in P. C. B. with a fall of 50' in 900' (Sew. T. w.),	353
<i>Slickensides</i> in P. C. B. connected with horsebacks, &c.,	<i>333</i>
Slickensided clay inside changes to laminated clay at the out-crop, 303; pots of slickensided clay in the roof of Redstone C. B., de- veloping into bad horsebacks (Ros. T. w.),	361
<i>Clay partings</i> in P. C. B. carry the sulphur,	57

	Page.
Clay partings (binders) numerous in Sewickley C.,	144, 145
Clay partings in Pitts. ore, knife edge out,	164
Clay partings of P. C. B. replaced by black shale,	333
Clay binders in P. C. B, 353; plastic clay inside the mine, and becoming laminated at the outcrop,	364
<i>Clay Veins</i> rare in P. C. B. in Blairsville basin,	58
Frequent and wide in Lisbon trough near Irwin,	61, 301
Clay Veins in E seen only on the Loyahanna,	79
Clay and fissures in SS. over S. C. B. north of Uniontown,	156
Clay suddenly replaces lower layers of thick sandstone,	184
Clay Veins numerous but slight in P. C. B., Brownsville,	235
In P. C. B. 4' wide, displacing all the coal,	267
Rare in P. C. B. in (U. T. w.),	273
Sends up a spur in P. C. B., Greensburg (H. T. w.),	298
None in extensive mines of Long & Co., Greensburg.	299
Not seen in the extensive P. C. B. mines at Brisbin's,	302
Enter the roof rocks, P. C. B., Barnhart's pits,	332
Traced for 450 yards, 6' wide, Foster mine,	333
Ruins the coal for 8' each side, Penn mines,	333
In P. C. B. (6'') in (Sal. T. w.),	315
Splits into thinner branches, twists and hurls the coal,	334
Tapers and disappears in roof-slate of P. C. B.,	334
Clay Veins in P. C. B. at Larimer, carefully described,	341, 342
Spars=small clay veins,	342
Branching Clay Veins,	341
Clay Streak, 4' thick, twists through the coal,	342
Coal Strings shoot into clay veins,	342
In main clay parting, <i>always pass upwards into coal</i> ,	355
Clay Veins numerous and horsebacks scarce, S. of Irwin,	344
Clay Veins and horsebacks together on Turtle creek,	346
Clay Veins characteristic of Redstone Coal Bed,	352
Vertical, narrow; injure P. coal for 2 yards each side,	353
Broad and numerous in R. C. B. (S. H. T. w.),	358
Cut out all but one bench of R. C. B. (Ros. T. w.),	361
Bad in R. C. B. at Webster (Ros. T. w.),	363
Clay Vein, extensive, joins a horse of clay; Wallace's,	369
Cuts roof rocks and through P. C. B. to the floor; Wallace's,	369
Thrown 4' to one side in crossing a parting in P. C. B.,	369
Faults the P. C. B. 10', in (E. T. a.) described,	375, 376
Sends spurs through faults in P. C. B., Logan's Hollow,	377
Clay Bands in R. C. B., large, but do not distort the coal,	377
Clay Veins common in P. C. B., in (V. T. a.),	381
Frequently subdivide; one followed 100 yards,	381, 382
Rare in P. C. B. in the patches around Pittsburg,	386
Frequent (6'' thick) in P. C. B. (Penn T. a.),	388
Twisted Coal, 156; curled and twisted by clay veins,	332
Curled and twisted by slickensides and horsebacks,	333
Curled coal adjoins good coal, in connection with fault,	370
Curled more on one side of a clay vein than on the other,	388
Soot vein in P. C. B. large; Sewickley Station,	353
Soot veins in P. C. B. at Logans Hollow (E. T. a.),	376, 377

	Page.
Soot veins very rare in P. C. B. in (V. T. a.),	381
Pots of coal in the Pittsburgh Sandstone,	271
Razor or blades in P. C. B., wedges of clay from the main parting, have no relation to clay veins,	382
Varieties in E excessive on account of the superincumbent pressure of Mahoning Sandstone,	370, 371
Variations in the dip of beds form the rule and not the exception,	23

PART IV.—Index—Miscellaneous.

<i>Alethopteris</i> good specimens in roof of R. C. B. (N. T.),	254
Alternations of coal and limestones, Larimer,	340
Analysis of S. C. B., 44; P. C. B. Legonier, 55; P. C. B. Blairsville trough, 57; P. C. B. Greensburg trough, 59; P. C. B. Lisbon trough, 60; P. C. B. Waynesburg and Nineveh troughs, 61; of C. B. E. Westmoreland Co., 70. <i>See Index of Coals, &c., above.</i> —Of Iron Ore over Wash. C. B., 28; New Geneva, Pittsburgh Group ore, 112; Oliphant's Furnace, 114; Big Bottom ore, 115; Red and Yellow Flag, 115; Blue Lump at Dunbar, 116; in upper L. B. Measures, 119; Snake Den or Johnstown ore, 119, 120; Hardman or Johnstown ore, 121; Freeport calcareous ore, Springhill F., 122; Coal Bank ore = Freeport calc. ore, Jacob's creek, 122; Furnace and Forge Vein, Jacob's creek, 123; Honey- comb ore, Springhill, Lemont, Dunbar, 127; Pin ore, Kidney ore, of XI, 128, 129; Big Bottom ore of XI, Fairchance, Spring- hill,	181
<i>Athyris subtilita</i> replaced by calc spar,	291
<i>Athyris sub-quadrata</i> in Limestone of XI,	291
Avenues to market from the district,	6
<i>Aviculo-pecten recti-lateraria</i> (44'—P. C. B.) Carr's Tun.,	276
Barren soil along the crest of Blairsville Axis on Brush and Huckle- berry ridges,	14, 16
Big Bend of Youghiogheny carries the Waynesburg Axis,	17
Black Slate over Waynesburg L. turns into L. W. C. B.,	34
Block coal in P. C. B. at Brownsville,	61
Blocks of SS (low in Bar. Meas.) on the Dunbar hills,	184
(Under U. Wash. L.) on divide bet. Redstone and Dunlap,	226
(Connellsville SS.) in (E. H. T. w.),	266
(Conglomerate XII) in (Mt. P. T. w.),	261
(Morgantown SS.) on Beaver run hills (Loy. T. w.),	324
<i>Bluffs.</i> <i>See</i> cliffs below.	
Bluffs of Jolleytown SS. National road (R. T.),	227
Of Waynesburg SS. and Upper SS. Nat. road (R. T.),	227
Of Pittsburgh SS. on Conemaugh at Blairsville,	284
Of Mahoning SS. on Sewickley Cr., Chambers mill,	307
Of Mahoning SS. on the S. W. Penn. R. R.,	308
Of Pocono SS. (No. X.) in Conemaugh Gap,	292
Bog Conglomerate,	168
Bone coal with vertical cleavage in Wayne. C. B.,	228
Boring (743' deep) Hutchinson's mills (S. U. T.),	157
Salt well, Lick Hollow, Nat. road, doubtful,	159
At Brownsville (600'—P. C. B.),	234

	Page.
On Sewickley creek (450' to 40' rock, XII),	807
At Paintersville, (H. T. w.), records,	809
On Turtle creek,	829
At Manor church, (P. T. w.) untrustworthy,	835
Bottoms of Turtle creek,	5
<i>Boulder, water-worn, found embedded in the Sewickley Coal Bed,</i>	
R. R. cut, Redstone creek,	218
Breakneck Furnace and Creek, (B. T.),	197
Brick layer (4" to 8") of the Waynesburg Coal Bed, Dunlap's Creek, always present and always ashy and worthless,	228, 229, 230, 231
Briery mountain of W. Va. not the Laurel Hill but the Negro Moun- tain of Pennsylvania,	10
Brine (see Boring; Salt) in Pottsville Cong, XII,	310
Strength and capacity on Sewickley Creek,	310
Brush Ridge crest higher in Westmoreland than Fayette,	2
Building sand (H. T. w.),	296
Building stone over Wayne. C. B. in (B. T.),	237
Lower Great Limestone (7' to 15') in (Mt. P. T. w.),	259
Pittsburg Sandstone, Saxman's run (D. T. w.),	282
Morgantown SS. Port Perry, &c.,	67; 383
Lower part of Barren Measures, Dunbar Cr.,	185
Mahoning SS. on S. W. Penn. R. R.; Salesburg,	308; 317
Poocono Sandstone, No. X,	106
<i>Calamites</i> replaced by Blue Lump Iron ore,	182
Impressions in the R. C. B. partings (E. T. a.),	374
Calo-spar replaces <i>Athyris subtilita</i> ,	291, 292
Cannel coal bed of Peytona = E.,	87
Bone layer in Waynesburg bed,	84
Slaty, 142' + P. C. B. Greensburg (H. T. w.),	296
Shale between upper and lower Great Limestone,	38
Shale under G. L. = Sewickley C. B.,	44
Poor (1' thick) R. C. B. St. Clair,	280
Shale, upper bench of R. C. B. (Ros. T. w.),	360
Top of R. C. B. (10") Webster (Ros. T. w.),	363
Cannel in P. C. B. in (Sal. T. w.),	315
Semi-Cannel in P. C. B.,	339, 340
Fine cannel (4" to 10") top of under bench,	369
Fair (6") in shale roof of P. C. B. Kelley's,	379
Slate under P. C. B.,	181
Shale in coal bed E. (fig. 7),	76, 165
Cement Limestones, Nos. 4, 6, (Fig. 40) Greensburg,	295
Upper division of Great Limestone, sometimes cement in Fayette, but not in Somerset county,	87, 38, 41
Of Great Limestone at Mt. Braddock,	179
Under Uniontown Coal Bed, Uniontown,	162
Charcoal (mineral) in P. C. B.,	57
Cheat View, a fine prospect,	91
Chert bed (black) over E in W. Va. Key rock,	86, 87
Chester Limestone = Mountain Limestone of XI.,	102
Chestnut Ridge described, &c., &c.,	6, 11, 13
Clarion Coal bed = ? A. = Mt. Savage,	88

	Page.
Classification of Rock formations, Chap. 2,	8
Clay, <i>see Fire Clay; see in Index of Structure</i> ,	79
Under-clay of E used for glass furnace pots,	138
Under Freeport Limestone described,	80
Under Kittanning coal (S. T.) never plastic,	140
Cliff Sandstone of Tennessee = Pottsville XII,	94
<i>Cliffs</i> — <i>See Bluffs above.</i>	
Of Waynesburg, SS. 65' to 70' in German and Luzerne TT.,	32
(30'—40') on Redstone, at Cook's mills (R. T.),	227
(30') north of Brown's run, (G. T.),	246
Of Connellsville SS. along Dunbar creek; 70'—90' below P. C. B. in (N. T.),	183, 251
Of Morgantown SS. Dunbar Creek, 183; on Yough. in (P. T.), 206; 100' high opposite Saltsburg; and on the Loyalhanna river,	217
Of SS. of the Barren Measures (30') on Rubble's run, Springhill Furnace, 137; and at Layton Station (P. T.) under coal bed,	206
Of Mahoning SS. (70' +) at Morgantown,	85
On Buckhannon river—W. Va.	85
Of Piedmont (?) SS. (20') up Chestnut Hollow in (N. U. T.), 110' below E.,	173
Of Pottsville SS. XII, on Decker's creek,	92
On Piney Knob, (S. U. T.),	159
(40') on Shute's run (N. U. T.),	168
1½ miles east of Lemont F. (N. U. T.),	173
Of Pocono SS. X, on Chestnut Ridge,	11
<i>Coal</i> .— <i>See Index of Coals, &c., above.</i>	
<i>Coke Region</i> , 20; Special Report L, 195; ovens in (T. T.), 198; of Le- mont F. (N. U. T.), 169; Enterprise Works, Stonersville, Over- ton, (E. H. T. w.),	267
<i>Coke of R. C. B. cakes less than that of P. C. B.</i> ,	204, 205
Coke from P. C. B. Oliphant's F., 147; Loyalhanna Stat.,	281
Coke from P. C. B. slack, Brownsville, 235, 236; Greensburg, 298; Larimer, 350; Waverly C. Co.,	355
Coke from bed E, good,	138
<i>Columnar Coal</i> , P. C. B., Saltsburg (<i>See prismatic</i>),	322
<i>Concretions</i> , large in Morg. SS. Dunbar creek,	184
<i>Conemaugh river</i> described,	5
<i>Conglomerate</i> .— <i>See Pottsville SS. No XII. See Index of Structure.</i>	
Layers of Cong. in Morgan. SS. on Loyalhanna,	317
Rare in Mahoning SS. in North of W. Va., but common in Ran- dolph and Upshur counties,	85
In Freeport Sandstone,	371
Under 100' of red shale at Monroe (N. U. T.),	166
Of Limestone fragments in XI,	99
Key rock (568' below L. of XI) in X,	293
Made of pebbles of iron ore—description,	201
Made by a Chalybeate spring,	168
<i>Débris</i> covers the flanks and vales of Chestnut ridge and thick along the Greensburg pike,	277, 288, 348
<i>Divides</i> between Mount's Cr., Redstone and Dunlap creeks,	4, 226
<i>Drainage</i> of the district described,	2, 4, 23

	Page.
Eighty foot rock (XII) ; Coal bed (R. C. B),	809, 47
Elevated plains of the Monongahela Valley,	2
Error in Fig. 6. Coal 13 should be called Elk Lick,	65
In Fig. 6 Crinoidal should be Green Cr. L.,	65
Error in "Notes on Geology of W. Va." Nuzum's mill coal bed is D (D') and not E,	88
Error in R. of P. K. 1875. Waynesburg L. <i>not</i> local,	35
In R. of P. K. 1875, the Green and Black Limestones confounded, . .	68
Errors of miners of ore on Smiley's hill,	175
Of miners of P. C. B. as to size of lower bench,	301
Feldspar grains in Mahoning SS.,	74
Ferriferous Limestone— <i>See Index of Coals, &c.</i> ,	89, 139
Fire brick, 140 ; Fire damp in P. C. B.,	345
<i>Fire clay, see Clay above.</i> Persistent along Cheat River,	187
Under P. C. B. (3') Kelly's run (E. T. a.),	379
Under E, good in the southern part of district,	79
Under Freeport Limestone at Saltsburg,	319
Very fine, 20' below Kittanning C. B. (S. T.),	140
On top of XII, Redstone creek (S. U. T.),	161
Under A, over XII, main bed = Mt. Savage, (?)	84
<i>Fish teeth</i> in shale over U. C. B. at Uniontown,	162
Flagstone under Wayne C. B., 34 ; over U. C. B.,	36
Floated mass of limestone dropped into a coal bed,	216
Forty foot rock = XII in Salt well,	307
<i>Fossils</i> , minute in Great L., replaced by calo-spar,	178, 179
Green Crinoidal L. numerous, 68 ; numerous at Lemont F., 171 ; plenty in (W. T. w.), 326 ; plenty at Elrod's Station (V. T. a.), 383 ; plenty around Pittsburg,	387
400' below P. C. B. at Stewart's Station on the Pa. R. R. very nu- merous, 14 species found,	350
440' below P. C. B., Carr's tunnel ; shells in clay,	276
In Mahoning SS. <i>Lepidodendra</i> ,	75
Wanting in the red shales of XI,	98
Tubes in Pin Ore of XI, filled with red shale,	128
In XI Limestone at Jacob's Creek gap, abundant,	100
In XI L. replaced by calo-spar,	166
In XI L. upper layers, Jacob's creek,	262
In XI L. lower or Chester Limestone,	102
400' below base of red shale, Randolph Co., V.,	102
In pockets of X (Waverly) in Ohio and W. Va.,	108
In Alabama—all Coal Measure Species,	105
<i>Fossil plants</i> plenty over Waynesburg C. B. (L. T.), 32 ; 237, 238, on Brown's run (G. T.) ; also,	248
Beautifully preserved in roof of R. C. B., Core's (N. T.),	254
Indistinct in R. C. B., at St. Clair,	280
Stems numerous in Pittsburg SS. in (D. T. w.),	286
Numerous in roof of P. C. B., mouth of Redstone,	236
Plant-bearing clay above P. C. B.,	52

	Page.
Impressions in roof of P. C. B., Masontown (G. T.),	342
Stems numerous, but leaves rare, over P. C. B. (E. T. a.),	374
In iron ore under P. C. B.,	182
Casts of stems in base of Conn. SS., Dunbar Cr.,	183
Stems in coarse SS. 400' below P. C. B., Carr's Tun.,	276
Stem impressions and casts in Mah. SS., Sew. Cr. (H. T. w.),	310, 359
In black shale under Mahoning SS., in W. Va.,	85
Impressions in E; plank bed <i>over</i> E,	192; 86
Badly preserved in sandstone conglomerate below E,	371, 202
Stems turned to coal in XII,	92, 93, 105, 290
Fragmentary coal bed,	50
<i>Fucoid</i> ? casts, Pin Ore, Smiley's hill (N. U. T.),	174, 175
Gangways at Irwin described,	24
Gaps in the Mountains,	2, 3, 5, 8, 11, 13, 190
Gap of the Sewickley creek below mouth of Redstone,	5
Gap or ravine of Redstone in Chestnut Ridge,	161
Gas Coal, S. C. B. best (S. U. T.), 156; P. C. B. (P. T. w.),	333
Gas in salt-well at 788' below P. C. B. at Brownsville, still flowing after 30 years,	284
<i>Geology by Townships, Part III, ch. XI—See Table of Contents.</i>	
Glass sand of Piedmont SS., above Connellsville, 193; (P. T.),	206
Gorge-like Valleys of Fayette County,	4
Hills of the Youghiogheny River,	5
Hog-back ridges of the Barren Measures,	167, 171
Horizons in the Barren Measures hard to make out,	70
Identification of sandstones hazardous,	51
Interconglomerate Coals of Fontaine & Safford,	93, 94
Intervals between Up. Wash. SS. and Wayne C. B. 330',	226
Between Wayne C. B. and P. C. B. 250',	238
Between U. C. B. & G. L. diminished,	37
Between R. C. B. & P. C. B. 18', 15', 9' (H. T. w.),	49, 297
One interval cut down from 170' to 60',	284
<i>For other cases, consult Index of Coals and Index of Structure.</i>	
Irisled coal of P. C. B.—(Sal. T. w.),	313
Knob of Dunbar's Camp in (D. T.),	176
Knob (600' high) over Yough. River, Sheplar's Knob,	365
Lemont Furnace on Cove run (N. U. T.),	168 to 171
Laurel Ridge <i>East</i> and Laurel Hill <i>West</i> of Ligonier Valley,	11
Layton Station, Upper, Middle, and Lower Coal beds, 85', 185' and 220 below Green Crinoidal Limestone,	69, 206
Lead and Zinc in Pocono SS. No. X (doubtful),	109
Ledge of Piedmont SS. along face of Chestnut R.,	173
<i>Lepidodendron</i> , huge impressions in the Mahoning SS. well pre- served,	75

	Page.
<i>Lepidodendron obovatum</i> in Mahoning SS. abundant, large and good, on Cove run, (N. U. T.),	172
Levels along Chestnut Ridge, 1; of the terraces, 2; of the Dunbar creek divides, 3; of the National road (2,400'), 12; along the Blairsville synclinal. 19; of hills in the Connellsville basin, 55; of Henderson's and Moreland's hills in (D. T.), 600' lower than Chestnut Ridge, 177; of road over W. C. B. (150' +) on line or (M. T.) and (R. T.), 224; of P. C. B. on Brown's run hills (G. T.), 244; of P. C. B. (1,000' + tide) on Turtle creek at Patterson's (F. T. w.), 329; of P. C. B. (140'—P. R. R. track) E. of Penn Station, 336; of Waynesburg C. B. 240' + Monongahela River (L. T.), 238; of W. C. B. a. 260' + N. Newton depot in (S. H. T. w.),	356
<i>Lima retirifera</i> , 440' below P. C. B.,	276
Lime burned with Washington C. B.,	365
Limestone becomes ore; replaces ore,	89; 191
L. lies between two layers of coal,	340
L. holds a coal bed between its two layers,	66
L. sends off local layers without diminishing the size of main bed,	371
L. replaced by sandstone over W. C. B. a.,	28
L. when weathered appears to be a sandstone,	99
<i>Limestone waterworn fragment imbedded in the Sewickley coal bed on Redstone Creek</i> ,	216
L. the floor of the Sewickley coal bed,	43
L. of U. P. C. M. 42' in 70' of section, N. of Uniontown,	155
L. of U. P. C. M. in the Ligonier Valley,	41
L. of U. P. C. M. in Hempfield and Sal. T. w.,	316
L. of Sheplar's Knob, 600' above Yough.,	365
L. under second thin coal below P. C. B.,	145
L. of Bar. Measures very variable in number and size,	72
L. reported in Lick Hollow salt well too numerous,	159
L. at Nuzum's mills, W. Va. = Freeport L.,	88
<i>Limestone breccia</i> of XI, with fossils,	99
L. of XI on National road, 1 M. S. E. of Monree,	166
<i>Limestone Soils of the district KK</i> ,	6
<i>Lithostrotion</i> from L. of XI near Lewisburg, Greenbriar Co., W. Va. proves its age,	102
Lower Carboniferous Series discussed,	96
<i>Magnesian limestone</i> —See <i>Great limestone</i> ,	164
Mauch Chunk red shale, (Umbral) XI,	96
Maxville = Chester = Lower Limestone of XI,	102
McAllister's Ridge in Va. = Laurel Ridge,	10
Mines at Irwin, 24; 2,500' long at Dunbar, 189; at Breakneck F. abandoned,	197
Mining iron ore cheapened by coal floor,	127
Monongahela River water system,	4
Mountain Limestone = Umbral L. of XI,	98
<i>Neuropteris cordata</i> numerous in the roof slates of P. C. B. at mouth of Redstone creek; fine in roof of R. C. B.,	236; 254
Nomenclature of Prof. H. D. Rogers,	8
28—KK.	

	Page.
Notes on the Geology of W. Virginia,	82
Oil-break of W. Virginia,	86
Oil not found at Hutchinson's mill well,	158
Oil from SS. 600' below P. C. B. at Brownsville,	234
Oil not found in second well up Dunlap Cr.,	235
Oil—salt well at Brownsville; earliest oil strike in S. W. Pa. 1846,	234, 235
Oil boring on Jacob's creek in Chestnut R.,	263
Ore horizons—See <i>Iron ore index</i> ,	69, 70
Ore, roof clay, sandstone replace each other,	188
Ore and clay partings exhibited in section,	189
<i>Ostracoids</i> abundant in Great Limestone,	346
Paving stone quarry in L. of XI,	49, 194
Peacock coal—P. C. B. (U. T. w.),	273
Pebbles in SS. above Mah. SS. and below Morg. SS.,	185
Pebbles more numerous in Mahoning SS. than in XII,	92
Pebbles scarce in XII, 92; abundant and larger than eggs in XII south of the Youghiogheny, 93; (1") in XII (N. U. T.),	173, 174
Pebbles in X, 568' below L. of XI,	106, 243
Pebbles scarce from the <i>upper</i> , and plenty from the <i>lower</i> of the two Painterville wells,	310
Pebbles of <i>Iron ore</i> in SS. of Bar. Meas.,	201
Percentage of Volatile Matters in Coal,	62
Persistence of iron ore beds,	117
Persistent beds to be found in the B. Measures,	65
Petroleum (<i>see Oil</i>) 600' below P. C. B.,	234
Peytona cannel, in W. Va. = E (?),	87
Physical features of the district Chap. I,	1
<i>Plants</i> —See <i>Fossils</i> .	
Plain-terrace of Mount Pleasant,	4
Plastic clay under E.—See <i>Clays and fire clay</i> ,	79
Pocono Sandstone = Vespertine = No. X,	105
Pottsville Conglomerate = Seral = No. XII,	91
On the arch in the Gap of Cheat river,	13
Pressure downwards of SS. on Coal beds,	282
(<i>See Index of Structures for facts under this head.</i>)	
Prismatic coal, in Waynesburg C. B. a (R. T.),	228
In P. C. B., 56; Mt. Pleasant, 256; in middle bench Ligonier Val- ley, 54; in (D. T. w.),	285
In E, lower bench (Fig. 7), 76; on Sewickley Cr.,	310
<i>Productus elegans</i> , in L. of XI, Loyalhanna Gap,	291
Quinnemont Series of coal beds,	93, 94
Railroads of the district,	6, 7
Rainfall rapidly carried off,	3
Red color of XI,	98
Report of Progress in Somerset Co., HHH,	41
Ripple marks characteristic of Waynesburg SS.,	31, 32
Rogers' (H. D.) law of declining percentage of Vol. Mat. in coal,	62
Salisbury basin geology compared,	40, 52
Salt got on National road in Lock Hollow at depth of 407' and 568'. (<i>See Brine, Boring, Wells, &c.</i>),	159
Brine grew stronger in Ruff's well on Sewickley Cr.,	307
Sand for building (H. T. w.),	293

	Page.
Sandstone blocks on a good soil,	6
Replaces Limestone over Waynesburg C. B. a.,	28
Sandstone layers between Upper and Lower Great Limestone,	38
Identifications from section to section hazardous,	51
Massive on Redstone Creek in Barren Measures,	68
Massive in lower part of Bar. Meas. above N. Geneva,	68
Leached of its calcareous constituents,	99
85' thick thins abruptly to nothing,	184
Conglomerate lens-shaped masses in sandstone, resembling the Oil Sand phenomena,	185
Floor of ore bed, replaced by red shale from below,	189
Made into a conglomerate by small pebbles of ore,	201
Glass sand, on Yough. River at Laurel Station,	201
Glass sand of the Barren Measures (P. T.),	206
Parting of 1' Sandstone in P. C. B. (W. T.),	207
Friable Sandstone No. 9 (Fig. 40), near Greensburg, looks recent, but is not (H. T. w.),	296
<i>Sandstone containing fragments of Coal</i> ,	135
Section of Measures exposed in K.K. (2,750 feet),	9
At Dunbar, Measures over Pittsburg Coal,	50
Of No. X—Fig. 10—Of coals of No. XI,	97
Of Limestone of XI on Deckar's Creek,	101
Of XI and X in the Conemaugh Gap,	106
Along the Morgantown road in (S. T.),	133, 134
Of boring from 180' + P. C. B. down to X (743'),	157, 158
At Monroe—(N. U. T.),	166
Of XI at Turkey Nest (N. U. T.),	167
General Section on Yough. River, W. of Dawson,	200
In long R. R. cut on Yough. R., from Laurel St.,	201
Of rocks above P. C. B. at Lyons' Mill (J. T.),	210
Of coals in Bar. Meas. on Redstone (M. T.),	224
Of same in tunnel of Redstone R. R.,	236
General Section at Frederick (L. T.),	239
General Section on Brown's run (b. T.),	243
Of XI on Jacob's Creek; at Mt. Pleasant Furnace,	261; 263
Of rocks over P. C. B. on Saxman's run,	282
General Section on Bairdstown and N. Derry road,	284
General Section XII and XI, Gap of Loyalhanna,	290
General Section (885') from L. of XI down Con. Gap.,	291
In Salt-well at Paintersville (H. T. w.),	309
Full section at Sewickley T.,	351
<i>For other sections see Index of Coals, &c.</i>	
Seral = Pottsville Conglomerate, No. XII,	91
Shale mistaken for limestone,	162
Shale turns to Sandstone (Fig. 40) (H. T. w.),	296
Sharon Coal bed; Groups, under XII,	103, 105
Side-throws in coal— <i>See Index of Structure</i> ,	223
<i>Stigillaria</i> impressions in bony plies of Wash. C. B.,	365
Silicious limestone, lower part of L. of XI,	99
Silver-lead in X in W. Va.,	109
Soil of the district, 6; of the Vespertine, X, 13; barren along Huck- elberry and Brush ridges,	14, 16

	Page.
Somerset County Geology,	41
Spar replaces coral ? (G. T.),	243
<i>Sphenophyllum</i> , fine specimens in roof of R. C. B.,	254
<i>Spirifer plano-convexus</i> in Green Crinoidal Limestone,	337
Makes up nearly the whole mass, W. of Irwin,	349
Steam coal from P. C. B. Saltsburg,	323
<i>Stigmaria</i> in partings in E, White Rock Station,	192
Never occurs in P. C. B.,	192
Stockton bed of the Kanawha=E,	87
Stratford bed, local name for A (?),	83
Sulphur rock of the well borers, over A,	158
Surface concealed by debris,	73, 197
<i>Syringopora</i> (?) replaced by spar in Wayne. Limestone,	243
Terraces disguised by erosion, 1; become plains and pass into water sheds,	2
Terrace ("270 foot") of fine clay in Springhill T.,	136
Terrace detritus covers up exposures on Possum Creek,	178
Terrace sand imitated by U. Prod. C. M. Sandstone,	296
Thickness not to be accurately measured by dip,	13
Thickness of total exposures in district 2,750',	9
Of Barren measures on Monongahela—400'; on Yough river 560'; on Dunbar Cr. 520'; on Cove run 480'; on Conemaugh 550'; on Youghiogheny river 560',	70, 71
Of Lower Productive Coal Measures, including the Mahoning SS. in southern part of district 150'; sometimes 125'; north of Redstone 270'; in W. Va. 700', 900',	73, 90
Three foot coal on Jacob's creek=E,	264
Tionesta Sandstone=(?) Piedmont SS.,	82
Topography of the district,	1
Tracing the outcrop of P. C. B. difficult,	51
Transition beds of X and IX in the gaps,	105
Transported block of limestone of Coal Measure age,	216
Tubes filled with red shale in ore of XI,	128
Umbral formation = Mauch Chunk red shale, XI,	96
Iron ores of Rogers—See <i>Index of Iron Ores</i> ,	125
Upper Productive Coal Measures,	6
Valley of Barren Measures along foot of Chestnut Ridge, 288; of L. P. Coal Measures (S. U. T.),	157
Variations of L. under P. C. B. from 2' to 15'—See <i>Index of Structure</i> , under the head of <i>Variations</i> ,	348
Vespertine Formation=Poono SS, No. X,	96, 105
View fine from XII on Cheat river,	91
Volatile matters in coal; law of decrease,	62
Water-sheds continuations of terraces,	2
Water supply of George's Creek inadequate,	3
Well boring at Hutchinson's Mills (<i>See Borings</i>),	157
West Virginia geology,	84, 85
Whinstone = lower part of L. of XI,	159, 166
Yellow flag. See <i>Index of Iron Ores</i> ,	164
Youghiogheny River described,	5
Zinc blende (?) specks in ore of XI,	120

ERRATA IN THE REPORT ON GREEN AND WASHINGTON COUNTIES.

Persons obtaining this volume, and possessing the report on Green and Washington counties, are requested to make the following corrections in that report :

On the following pages read "Limestone I b" for "Limestone I a:"

Page 222, line 16.

" 262, " 13.

" 266, " 17.

On the following pages prefix an asterisk as indicated :

Page 352, line 1.

" " " 2.

" " " 8.

" 358, " 36.

" " " 44.

" 361, " 8.

" 362, " 22.

" 364, " 30.

" 366, " 47.

On page 365, line 19, strike out the asterisk.

" 354, " 43, for "200" read "290."

" 358, " 10, for "290 W" read "290 P."

" 397, " 14, for "but the coal" read "but the rock."

Where the term "Elk Lick" occurs it should be erased as a wrong identification, as explained in Part I, of the Report of Progress Q.

Table on page 334 K.

Text of page 340 K, line 24.

Map of Washington county.—

Amwell township :

At Ten-mile village for "140 P" read "140 W."

At next point west for "40 W" read "140 W."

Franklin township :

Southern part, for "Van Bruen" read "Van Buren."

Chartiers township.

On Chartiers creek for "60 P" read "60—P."

Fallowfield township.

Northern part, for "70 P" read "70—P."

ERRATA IN REPORT KK ON FAYETTE AND WESTMORELAND DISTRICT.

Page 82, line 18, after "has" insert "provisionally."

Illustrations of Erosion, Clay-veins, &c.

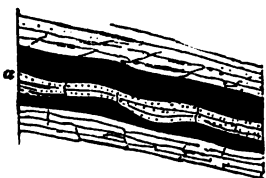


FIG. 459.

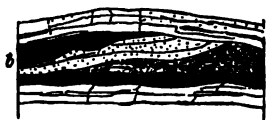


FIG. 469.

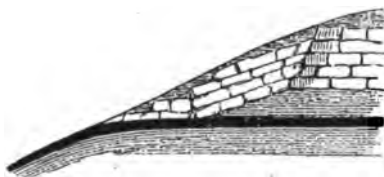


FIG. 528.

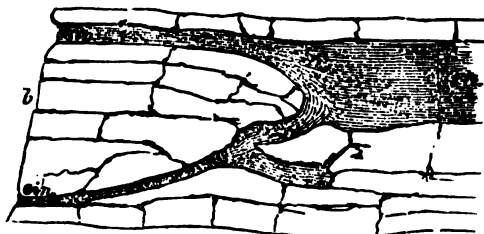
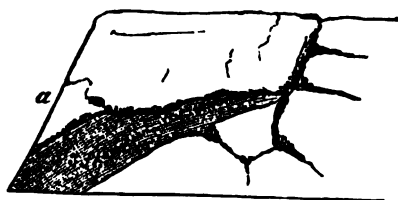


FIG. 529.

